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DIRECT/DELAYED RESPONSE PROJECT:
FIELD OPERATIONS AND QUALITY ASSURANCE REPORT FOR WATERSHED MAPPING IN THE MID-APPALACHIAN REGION OF THE UNITED STATES

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16. ABSTRACT

This report documents the mapping program of the Direct/Delayed Response Project (DDRP) in the Mid-Appalachian Region of the United States. The objectives of this report are to document the planning activities, field operations, and quality assurance/ quality control (QA/QC) of the mapping. The protocols, QA plan, and soil legend for the watershed mapping are presented as appendices.

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EXECUTIVE SUMMARY

The Direct/Delayed Response Project (DDRP) of the National Acid Precipitation Assessment Program is a United States Environmental Protection Agency (USEPA) program to reduce the uncertainties in current understanding of the effects of acidic deposition on surface water chemistry. The response of watersheds to acidic deposition is being assessed for selected study regions using data from DDRP watershed surveys, USEPA surface water surveys, and acidic deposition data. This document describes the planning activities, field activities, and the quality assurance/quality control (QA/QC) operations associated with watershed mapping in the Mid-Appalachian Region of the United States. The watersheds mapped were chosen from those characterized by the USEPA National Surface Water Survey.

These mapping activities produced soil, depth-to-bedrock, landuse, forest cover type, and drainage/water features maps of 36 watersheds. Soil map quality guidelines were based on those of the National Cooperative Soil Survey with minor modifications. Modifications were documented in DDRP mapping protocols which are included as Appendix A. The intensity of the mapping is order two. The map scale is 1:24,000 with minimum map delineations of two acres for hydric soils and soils formed in alluvium, and six acres for all other soils.

The mapping protocols were slightly revised from previous DDRP surveys prior to beginning the fieldwork. Comparability between DDRP surveys was promoted by using basically the same protocols throughout the project. Many of the soil scientists, who conducted the mapping, participated in a protocol training session and the other participants were trained by personnel familiar with the protocols. A correlation and mapping review workshop was held after the mapping was completed to correlate the soil legend and to complete work on map unit descriptions. The final soil legend is included as Appendix B. An exit meeting was held as part of the workshop to review field activities, to evaluate the adherence to protocols, and to make recommendations for similar future surveys.

The QA/QC procedures were outlined in a QA plan that is included as Appendix C. Field reviews conducted by US Department of Agriculture - Soil Conservation Service (SCS) State Soils Staffs, field reviews by a DDRP Regional Coordinator/Correlator (RCC), and independent map quality evaluations by the RCC provided QC during the field mapping. Mapping quality and adherence to the protocols were evaluated during these reviews. The field reviews evaluated whether mapping was of acceptable quality and answered questions from soil scientists about the protocols. Most commonly discussed during the SCS reviews was the choice between several very similar map units, the size of delineations, changes to slope classes, the addition of soil map units to the legend, changes in vegetation mapping, and minor cartographic mistakes. The naming of map units was also discussed such as naming a soil map unit a consociation rather than a complex. Deficiencies noted during the RCC reviews were minor and included questions about surface stoniness phases, taxonomic classification, forest cover mapping, and small areas of a differing soil that should have been delineated.

The RCC conducted independent quality evaluations of final maps for 8 of the 36 watersheds. Minor map revision was needed for 1 watershed because some areas of soil formed in alluvium larger than 2 acres had not been delineated. The mapping for all eight watersheds were judged as acceptable after minor revision. Discrepancies and comments resulting from the evaluations included a map unit complex that should have been a consociation, consociations that should have been complexes, soils that were taxadjuncts to named series, the need to add some stony or bouldery map units to the legend, incorrect slope classes, hydric soils greater than 2 acres that should have been mapped, and some areas of mineral soil near watershed boundaries less than 6 acres that should not have been mapped. The report by the RCC summarizing his activities and findings is included as Appendix D.

Quality evaluations by DDRP soil scientists and geographers at the USEPA Environmental Research Laboratory - Corvallis, provided a final check to ensure that correct data were digitized. It is crucial that mapping data be corrected before digitizing and that data be corrected entered into the geographic information system. Apparent discrepancies, such as inconsistent watershed boundaries, depth-to-bedrock maps that did not correspond to soil maps, insufficient written documentation, missing symbols, stream placement, whether streams are intermittent or perennial, and potential water contamination, were discussed directly with the field soil scientists and the SCS State Soils Staffs. Discrepancies were resolved and the maps were digitized. The quality of the digitization work was also checked. Soil transect data were statistically analyzed to determine a quantitative estimate of the quality of the mapping. The estimated quality was found to be adequate for the intended use of the data.

The overall conclusion is that the mapping met the quality goals of the DDRP. The completeness goal of mapping 100 percent of the preselected watershed was achieved. The goal for completeness of field documentation was achieved, but the amount and detail of field notes varied greatly. The SCS State Soil Scientists field reviews and map evaluations found no significant problems with the mapping. The RCC's overall conclusion was that the soil scientists did a very thorough and careful job and that, based on 20 percent of the watersheds, the mapping meets the requirements of the DDRP protocols. Statistical analyses of the transect data did not suggest any problem with the mapping and map unit composition estimates.

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1 INTRODUCTION

This report documents the watershed mapping program of the Direct/Delayed Response Project (DDRP) in the Mid-Appalachian Region of the United States. The objectives of this report are to document the methods, field operations, and quality assurance/quality control (QA/QC) of the mapping. The protocols, QA plan, and soil legend for the watershed mapping are presented as appendices.

PROJECT DESCRIPTION

The DDRP is an integral component of the acidic deposition research program of the United States Environmental Protection Agency (USEPA) conducted under the federally mandated National Acid Precipitation Assessment Program (NAPAP). The DDRP is managed by the USEPA Environmental Research Laboratory, Corvallis (ERL-C). The general goal of the DDRP is to reduce the uncertainties in current understanding of the effects of acidic deposition on surface water chemistry. The response of watersheds to acidic deposition is being assessed for the study regions of the NE Region, the Southern Blue Ridge Province (SBRP), and the Mid-Appalachian Region (Figure 1-1) using data from DDRP watershed surveys, results from the National Surface Water Survey (NSWS), and deposition data.

The four technical objectives of the DDRP related to atmospheric/terrestrial/aquatic interactions (Church et al., 1989) are:

(1) to describe the regional variability of soil and watershed characteristics,

(2) to determine which soil and watershed characteristics are most strongly related to surface water chemistry,

(3) to estimate the relative importance of key watershed processes in moderating regional effects of acidic deposition, and

(4) to classify a sample of watersheds with regard to their response characteristics to inputs of acidic deposition and to extrapolate the results from this sample of watersheds to the study regions (Figure 1-1).

Three increasingly complex levels of data analysis are being used for the assessment (Church et al., 1989): Level I - system description and statistical analysis; Level II - single factor response-time estimates; and, Level III - dynamic systems modeling.

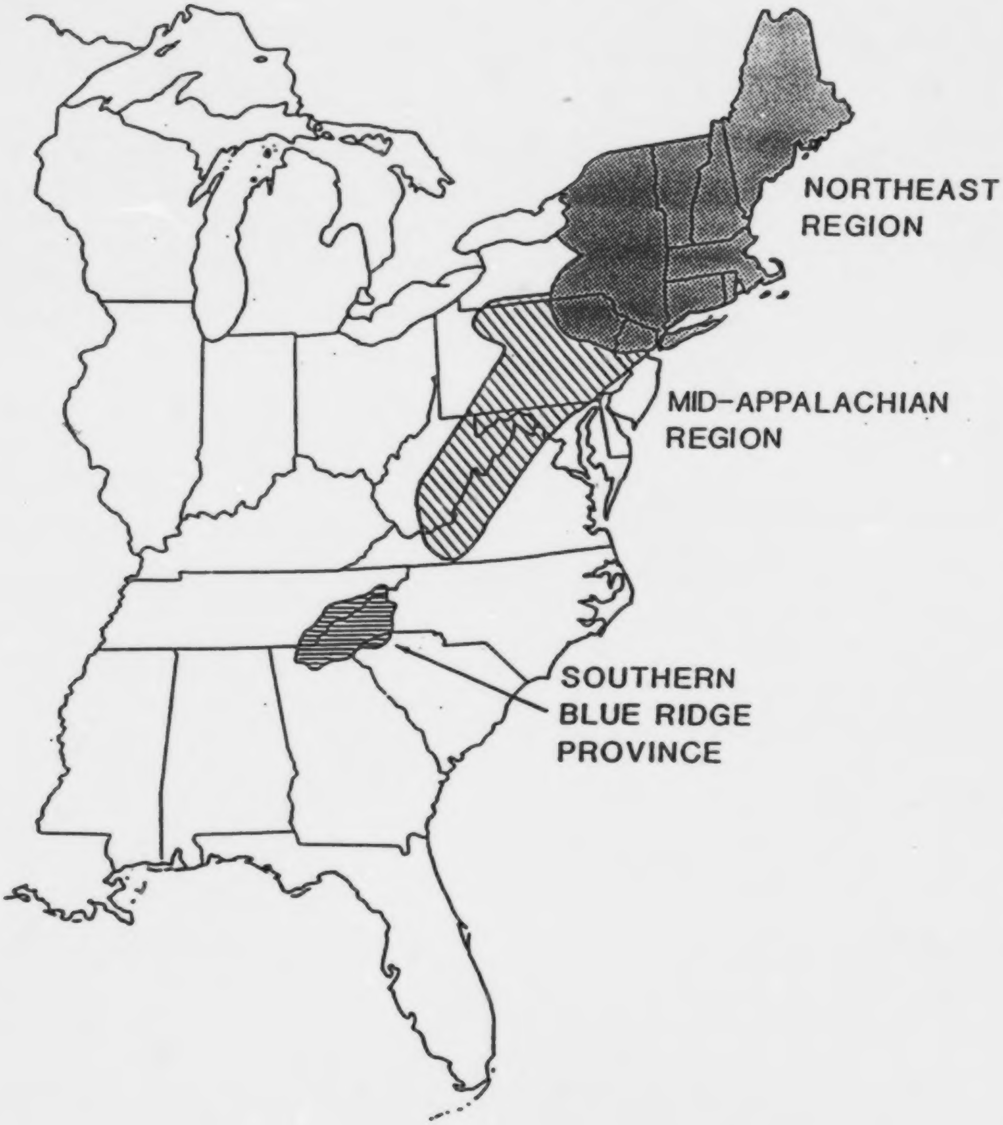

Figure 1-1 Study Regions for the DDRP

Level I analyses include statistical procedures such as cumulative distribution functions, cluster analyses, or other multivariate procedures, and steady-state calculations such as sulfur input-output budgets, watershed indices, and equilibrium chemistry predictions. These analyses are being integrated with available data on watershed characteristics to correlate ranges of variables that influence long-term watershed response to sulfur deposition.

Level II analyses represent order-of-magnitude time estimates for the rate of change of important watershed responses (e.g. time to steady state sulfate adsorption). These analyses will be used to estimate the rate of change of individual processes theorized to be important in controlling surface water acidification.

In Level III analyses the dynamic watershed models used are the Model of Acidification of Groundwater in Catchments (MAGIC) (Cosby et al., 1985a; Cosby et al., 1985b; Cosby et al., 1986a; Cosby et al., 1986b), Integrated Lake-Watershed Acidification Study model (ILWAS) (Chen et al., 1983; Gherini et al., 1985), and Enhanced Trickle-Down (ETD) (Lee, 1987; Nikolaidis, 1987; Schnoor et al., 1986). The models integrate the key mechanisms controlling surface water chemistry, including soil contact, weathering, anion retention, and base cation buffering, and will be used to project changes in water chemistry in response to scenarios of long-term sulfur deposition.

The goal of the watershed survey is to provide soil and other watershed attribute data for study regions in the DDRP. Watershed surveys have been completed in the Northeast (NE) Region, the Southern Blue Ridge Province (SBRP), and the Mid-Appalachian Region. An overview of DDRP watershed survey activities is given by Lee et al. (1989) and the results of the DDRP research in the NE and SBRP are presented by Church et al. (1989).

The specific objectives of the DDRP watershed surveys are to:

- characterize the variability of soil chemical and physical properties in watersheds of study regions, and
- provide data on other watershed characteristics (e.g. depth-to-bedrock, landuse, forest cover, drainage, water features and bedrock geology) across the study regions.

WATERSHED SELECTION

The watersheds chosen for characterization by the DDRP in the Mid-Appalachian region were all watersheds from Regions 2Cn and 2Bn of the Mid-Atlantic phase of the National Stream Survey (NSS) and some of the watersheds from Region 1D (Figure 1-2) of the NSS (Kaufmann et al., 1988) that met the following criteria:

1. watersheds of < 3,000 ha area;
2. acid neutralizing capacity (ANC) < 200 μeq/l; and,
3. minimal anthropogenic disturbances.

The locations of the watersheds that were mapped are listed in Table 1-1.

DESIGN OF THE MAPPING ACTIVITIES

DDRP mapping describe the spatial variability of soils, depth-to-bedrock, landuse, forest cover type, and drainage/water features. The protocols for the mapping activities are included in this report as Appendix A.

Soil Mapping

The procedures and quality requirements of the soil mapping are primarily based on those of the National Cooperative Soil Survey (NCSS). Federal leadership of the NCSS is provided by the US Department of Agriculture, Soil Conservation Service (SCS). The mapping standards are defined in the National Soils Handbook (Soil Survey Staff [SSS], 1983). Soils in this survey were classified according to Soil Taxonomy which is the soil classification system used by the NCSS (SSS, 1988; SSS, 1975). The final soil legend is included as Appendix B of this report. The intensity of this soil survey is order two, as defined by the SSS. This means that each map delineation was identified by traversing and that the type of map units used are consociations, complexes, and undifferentiated groups (SSS, 1984). In this survey the map scale is 1:24,000. The minimum size of delineations is about six acres for hydric soils and two acres for soils formed in alluvium. Small features, such as gravel pits and rock outcrops, were represented by special symbols.

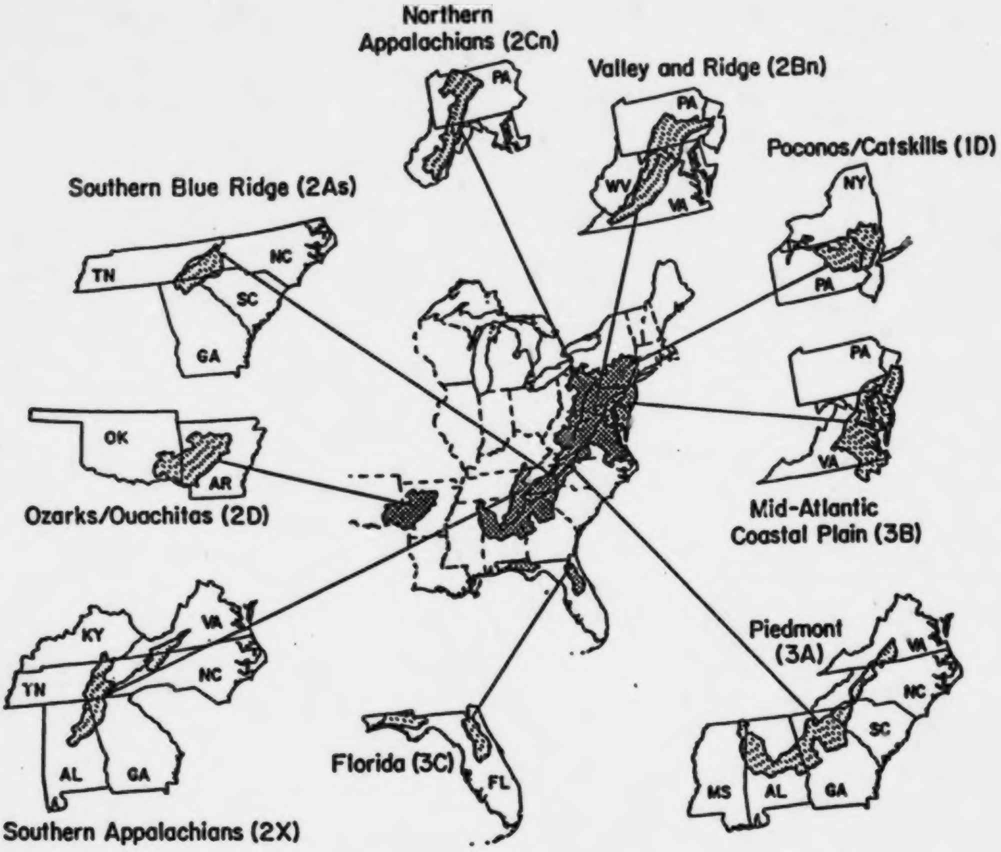

Figure 1-2 Subregions of the National Stream Survey
(Figure E-1 from Kaufmann, et al., 1988)

Table 1-1 Locations of the DDRP Mid-Appalachian Watersheds

ID Number	Watershed Name	State	Latitude	Longitude
			(decimal degrees)	
1D029023	North Branch Rock Run	PA	41.5467	76.8711
1D029031	East Branch Wallis Run	PA	41.4381	76.8611
1D029042	Heberly Run	PA	41.3264	76.3469
1D029043	Bowman Creek	PA	41.3486	76.2067
1D036011	Stony Run	PA	40.8819	76.2344
1D036017	No Name	PA	40.7889	76.0644
1D037005	Jeans Run	PA	40.8728	75.7733
2B036028	Boyers Run	PA	40.6239	76.9522
2B036046	Lower Little Swatara Creek	PA	40.5525	76.2681
2B041008	Piney Creek	PA	39.7936	78.4050
2C028075	Bear Run	PA	41.0150	78.5828
2C029020	Wolf Run	PA	41.0897	77.8686
2C035027	Williams Run	PA	40.4808	78.7717
2B036032	Burns Creek	PA	40.2278	77.7153
2C028070	Coldstream Run	PA	41.1128	78.3947
2C029002	Upper Dry Hollow	PA	41.6803	77.7753
2C028069	Whitney Run	PA	41.1283	78.5986
2C029016	East Branch Big Run	PA	41.1961	77.7453
2C041002	Fulton Run	PA	39.9428	79.4325
2B047036	Bible Run	VA	38.6444	79.0111
2B047066	No Name	VA	38.4053	78.2781
2B047076	Lewis Run	VA	38.3050	78.7458
2B047089	Moormans River	VA	38.1653	78.7447
2B047032	Elk Run	WV	38.6319	79.5858
2C041039	Buffalo Creek	WV	39.2608	79.7550
2C041040	Thunderstruck Creek	WV	39.2486	79.6008
2C041045	Right Fork Clover Run	WV	39.1475	79.7150
2C041051	Coal Run	WV	39.0397	79.6164
2C046005	No Name	WV	38.6856	80.5522
2C046033	Johnson Run	WV	30.0472	80.4081
2C046034	Hateful Run	WV	38.3511	80.2586
2C046050	Hendricks Creek	WV	38.1253	80.9822
2C046041	No Name	WV	38.2211	80.7153
2C047007	Crawford Run	WV	38.7589	79.9233
2C047010	Clubhouse Run	WV	38.6322	79.7605
2C057004	Butler Branch	WV	37.9561	80.9428

Soil map units are representations of naturally occurring segments of the landscape that are delineated on a map. Specifications of map units can be found in the National Soils Handbook (SSS, 1983). Map units are described in terms of geomorphic characteristics and the relative proportion of soil and/or miscellaneous area components that occur within map delineations.

The soil map units were described by the following characteristics;

- regional landform,
- local landform,
- geomorphic position,
- slope configuration, and
- percent composition of map unit components.

The soil components, that comprise map units, were described by the following characteristics;

- phase (e.g., slope, texture of the surface layer, stoniness),
- drainage class,
- permeability class,
- parent material, origin, mode of deposition,
- depth-to-bedrock, and
- taxonomic classification.

Depth-to-Bedrock Mapping

Depth-to-bedrock maps were prepared by soil scientists by combining contiguous delineations of soil map units with the same depth-to-bedrock class. Depth-to-bedrock estimates were determined by examination and observation of soil profiles, roadcuts, excavations and stream incisements. The mapping was transferred by the field soil scientists to mylar overlays on US Geological Survey (USGS) quadrangles or orthophotoquads at a scale of 1:24,000. One to three depth classes were assigned to each map delineation. The depth-to-bedrock classes reflect major soils in the delineation, not map unit inclusions. The depth-to-bedrock symbol for a map delineation are the depth-to-bedrock classes in descending order of estimated extent. Where appropriate, soil map delineations were segmented into more than one depth-to-bedrock class. The depth-to-bedrock classification is different than the soil depth classes used by the NCSS (SSS, 1983). A comparison of the two systems is presented in Table 1-2. The depth-to-bedrock delineations with classes I, II, and III are expected to have a higher level of confidence than deeper classes because of the difficulty of excavating by hand to deeper than two meters (Appendix A).

Landuse and Forest Cover Mapping

Soil scientists prepared a landuse/forest cover map of each watershed from field study and photo interpretation. The mapping was transferred to mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Landuse was designated by the landuse code types used on the SCS computer entry Soil Description Form. Forest cover types were those defined by the Society of American Foresters (Eyre, 1980).

Drainage Mapping

Drainage features maps were prepared on mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Standard map symbols shown in the mapping protocols (Appendix A) were used to show all perennial streams, dominant (well-defined) intermittent streams, water bodies and other water features. Marsh or swamp symbols were used to show areas less than two acres with standing water; larger marsh or swamp areas are delineated on the overlay and labelled "S". The upper end of perennial streams are marked with a short red lines across stream symbols. If a USGS topographic map was used, care was taken to make any corrections to changes in drainage since the original map was prepared.

Transects

The field soil scientists and the Regional Coordinator/Correlator (RCC) conducted transects that recorded the map unit name, location, transect length, transect interval, a brief profile description and the series name for each transect stop. Soil scientists identified at least one transect for each map

Table 1-2 Comparison of DDRP and SCS Depth-to-Bedrock Classes

Depth (meters)	DDRP Class	SCS Class
0 - 0.25	I	Very shallow
0.25 - 0.50	I	Shallow
0.50 - 1.0	II	Moderately deep
1.0 - 1.5	III	Deep
1.5 - 2.0	III	Very deep
2.0 - 5.0	IV	Very deep
5.0 - 30.0	V	Very deep
> 30.0	VI	Very deep

unit delineation. If the map unit delineation was greater than 160 acres, 1 transect was identified for each 160 acres. The transects were chosen to represent the typical landscape of the area delineated and usually were oriented at right angles to the drainage patterns. Soil scientists conducted 1 transect for each kind of map unit if there were 10 or fewer different kinds of map units in each watershed. Watersheds with greater than 10 different kinds of map units had transects conducted on 10 plus 1 additional transect for every 2 additional kinds of map units. More details about transects are presented in the mapping protocols (Appendix A).

The RCC conducted transects on 8 of the 36 watersheds. The Mapping Task Leader selected the map units for the RCC to transect in order to have data from both the soil scientist doing the mapping and the RCC for the same map units. A statistical evaluation and comparison of the transect data is presented in Section 4. A discussion of the results of the RCC transects is given in the report of the RCC (Appendix D).

2 PROJECT QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITY

PROJECT ORGANIZATION

The Mapping Task Leader from ERL-C had overall responsibility for the field activities and documentation. The Mapping Task Leader maintained the mapping information database that contains the identification legend, the classification, and description of map unit composition.

The RCC was an independent contractor who provided QA/QC oversight for the fieldwork. The RCC maintained a uniform, consistent regional mapping legend, participated in at least one field review for each state as an audit of field mapping procedures and mapping quality, and evaluated the quality of the mapping in 20 percent of the watersheds.

The SCS State Soil Scientists for PA and WV, with the support of the State Soils Staff, were responsible for the field activities by personnel from their states. [illegible] included supervising and coordinating field crews, conducting at least one progress field review as an audit of each soil survey party, working with the RCC to ensure regional consistency, forwarding completed maps with field notes to the Mapping Task Leader, and participating in training field crews.

The DDRP ERL-C QA Coordinator worked with the QA Staff of ERL-C to coordinate and document QA/QC activities. The QA Coordinator evaluated final map quality with the Mapping Task Leader, helped coordinate the QA/QC activities of ERL-C geographers, and was responsible for the preparation of the Field Operations and QA Report.

The Soil Survey Parties, led by a soil scientist, mapped the watersheds, described soils and soil map units, and conducted transects across map delineations to determine map unit composition.

PROJECT RESPONSIBILITY

Soil Survey Parties

The soil scientists assigned to conduct the mapping had the following responsibilities:

- conducted field investigations and aerial photo interpretation in order to delineate map units,
- traversed or visited all map delineations in the field,
- recorded observations and problems systematically in field notes, and

- conducted randomly selected transects used in the determination of soil map unit composition.

USDA-SCS State Soils Staffs

The State Soils Staffs had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- trained soil survey parties in and supervised adherence to the mapping protocols,
- conducted field reviews that were to include at least one watershed for each mapper,
- reported and resolved mapping problems in an expeditious and uniform manner,
- conducted follow-up reviews to ensure that any necessary corrective actions had been taken,
- measured and tallied area of each soil map unit by watershed,
- prepared reports presenting results of the above tasks, and
- reviewed mapping products and sent the products to ERL-C.

Regional Coordinator/Correlator (RCC)

The Regional Coordinator had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- participated in training,
- conducted transects on selected map units to evaluate the correctness of the mapping,
- evaluated mapping on about 20 percent of the watersheds by aerial photography interpretation and field investigations,
- participated in at least one progress review for SCS personnel from each state,
- evaluated state field review reports, and
- prepared reports presenting the results of the above tasks..

Mapping Task Leader

The Mapping Task Leader had the following responsibilities:

- managed and directed the mapping,
- worked with the DDRP ERL-C QA Coordinator to coordinate and document QA/QC activities,

- developed mapping protocols,
- provided initial instruction on mapping activities,
- evaluated progress reviews,
- coordinated with the SCS and the RCC to ensure that any necessary corrective actions were taken to resolve identified problems,
- selected watersheds and transects to be evaluated by the RCC,
- received and stored all interim and final reports, maps and other products,
- supervised final map checks and corrective actions before maps were digitized, and
- maintained the mapping database.

Quality Assurance (QA) Coordinator

The DDRP ERL-C QA Coordinator had the following responsibilities:

- prepared the QA Plan,
- evaluated final map products,
- coordinated review of final map with geographers,
- worked with the ERL-C QA Staff to ensure that QA requirements were being fulfilled,
- facilitated the exit meeting, and
- prepared the Field Operations and QA Report.

3 SOIL MAPPING OPERATIONS

PREPARATION FOR FIELD MAPPING

Preparations made before the initiation of field work included the development of protocols, a preliminary soils legend, the schedule of field work, and the contracting with qualified personnel to conduct the mapping. The Mapping Task Leader was responsible for the planning and monitoring of the mapping operations.

Development of Mapping Protocols and Preliminary Legend

The mapping protocols (Appendix A) were first developed for the 1985 DDRP NE mapping, were revised for the DDRP SBRP and the Mid-Appalachian survey. The protocols used for this mapping were the same as used in the DDRP additional NE mapping. The protocols have remained largely unchanged throughout the DDRP surveys and were all based on NCSS guidelines. The minimum size delineation for hydric soils and soils formed in alluvium was 2 acres; whereas, in the original NE and SBRP surveys the minimum delineation for all kinds of soils was 6 to 10 acres. The original DDRP NE mapping did not include landuse mapping by survey parties. The procedures for locating and selecting transects are different in all the versions of the protocols. In the NE survey, transects were conducted across entire watersheds passing through as many delineations as possible with 33 m intervals for recording observations. The total number of observations depended on the watershed area: <500 acres, 50 observations; 500 to 1,000 acres, 75 observations; 1,000 to 2,000 acres, 100 observations; >2,000 acres, 150 observations (Lammers et al., 1987a). In the SBRP survey the protocols stated that the RCC would randomly select the delineations for transecting for each kind of map unit after 80 percent of the mapping was complete. Transects were located perpendicular to the drainage pattern and crossed most of the delineation. There were ten evenly spaced observations for each transect (Lammers et al., 1987b). In this survey and the additional NE survey, the delineations for transecting were selected by the field soil scientists. Soil scientists conducted 1 transect for each kind of map unit if there were 10 or fewer different kinds of map units in the watershed. Watersheds with more than 10 different kinds of map units had 10 transects plus 1 additional transect for every two additional kinds of map units. The change of transect procedures between surveys has no effect on data quality. The mapping itself was conducted similarly but the change in transect procedure gave a slightly different perspective about the quality of the data.

The preliminary legend was developed at a two day meeting in Bedford, PA in September 1988. Representatives from SCS in PA and WV with the RCC developed a legend of soils from legends for existing soil surveys within Major Land Resource Areas (MLRA) in the DDRP Mid-Appalachian Region and soils that they expected would be mapped based on their experience. The final legend is included as Appendix B.

Mapping Personnel and Training

The survey was implemented through interagency agreements between the USEPA and the SCS. The SCS was chosen because it has a staff of trained soil scientists located in the study region, who have experience producing maps according to the guidelines of the NCSS. The SCS State Soil Scientists for PA and WV prepared work plans to arrange for personnel and equipment to carry out the mapping.

A training workshop was conducted by the USEPA 30 September to 2 October 1988 at the US Forest Service, Fernow Experimental Forest, near Parsons, WV to familiarize the soil scientists with the protocols. One soil scientist from PA attended and who then provided on-the-job training in the mapping protocols to the other PA soil scientists. The training workshop was attended by four WV soil scientists and a representative from the WV State Soils Staff.

FIELD MAPPING AND COMPILATION

Mapping activities were initiated in the fall of 1987 and were completed in summer of 1988. Map compilation and cartography was conducted by the field soil scientists. The area of map delineations were estimated by the SCS by using a dot grid or a planimeter. A digital planimeter was preferred for both accuracy and speed by those who had access to one. The total area of each map unit within a watershed was obtained by summing the area of individual polygons. The map symbol, map unit name, and area of each map unit in acres were listed in a legend on each soil map. Estimates of the total area of each map unit were used during correlation. A more accurate measurement of the area of map delineations was obtained after the maps were digitized from a rectified map base and entered into a computerized geographic information system (GIS).

Aerial photographs of each watershed at a scale of 1:24,000 were produced for this project with color-infrared and black-and-white prints. Film positives of USGS 7.5-minute topographic quadrangles or enlarged 15-minute quadrangles, when 7.5-minute quadrangles were not available, were used as a rectified map base.

CORRELATION OF THE SOILS AND SOIL MAP UNITS

Soil correlation is the process of maintaining consistency in naming, classifying, and interpreting soils and units delineated on maps. There are two main elements of soil correlation; first, the correlation of an individual soil pedon or groups of soil pedons with a soil series, or with some higher level soil taxonomic class, and second, the correlation of map units. Correlation requires consistent methods of observation and measurement among all participants, as well as the use of consistent conventions and terminology. The National Soils Handbook (SSS, 1983) and Soil Taxonomy (SSS, 1988) provide the conventions and guidelines for defining and naming map units, and for defining diagnostic properties and taxonomic classes of soils used in the NCSS. Soil series are described by SCS Official Soil Series Descriptions (SSS, 1983).

Correlation During Mapping

The soil scientist responsible for mapping each watershed performed the first level of correlation of the soils and map units. The descriptions of official soil series were adopted to represent those soil series for the region. At points along a traverse, the soil was examined and evaluated for characteristics that were within the range of a soil series or that were similar to an established series. Soils with properties outside the range of established soil series were classified at the family level or higher taxonomic level. Brief descriptions were made of the different kinds of soil to document what was observed and to compare or correlate with the Official Series Description or other field descriptions. The descriptions of the different recognized kinds of soil were further evaluated by the State Soils Staff during progress field reviews for consistent correlation within each state. In addition to the proper recognition and classification of soils observed, the soil scientist also determined the relative proportion of each kind of soil on a landscape segment. In this manner, soil map units were defined. The soil scientist then correlated the composition of soils with one of the map units in the preliminary legend or proposed an additional map unit. The map units were reviewed by the State Soils Staffs to correlate map units on all watersheds within each state. The RCC controlled the mapping legend and correlated soil map units throughout the region.

Correlation and Mapping Review Workshop

The soil correlation workshop was held in Corvallis, OR, 22 to 25 August 1989 in conjunction with a workshop to develop sampling classes for the sampling phase of the survey. The objective of the correlation segment of the workshop was to produce a correct and consistent mapping database. This task included correlation of soil taxonomic units and soil map units, resolution of map unit composition, completion of missing data, verification of soil component and map unit data, and correction of map discrepancies.

Soil Identification Legend --

Corrections were made to the mapping database resulting from decisions made during the correlation segment of the workshop. The computer data files were corrected and printed for editing by workshop participants. These updated computer files were used during the sampling class development segment of the workshop to sort soil components into proposed sampling classes and, following the workshop, to allocate pedons to sampling classes and watersheds for sampling. Map units were added to the legend on the approval of the RCC as mapping progressed. As expected, several map units initially listed on the legend were not used in the mapping.

Prior to the correlation workshop, the delineated area of each map symbol on each watershed was estimated by the SCS using dot-grids. Final estimates of areas were made using computerized maps. These estimates were entered into a watershed legend file. From this file a summary of map symbols with total acres of each map unit in the region was generated. The watersheds on which the map units occurred were also listed on this printout. The estimated regional areas of the map units were merged with the preliminary identification legend file.

Workshop participants first reviewed the preliminary legend to verify that all map units used were listed. Five map units were added to the legend, and map units that had not been used were marked for deletion. About 15 corrections were made to the phase part of map unit names (e.g. Mandy channery sandy loam changed to Mandy silt loam). The name of a major soil was either added to or deleted from the name of 18 map units (e.g., 94C, Wellsboro channery loam was changed to Wellsboro-Lackawanna channery loams).

Other map units that were of little extent (< 20 acres) were combined with similar map units (e.g. 8 acres of 32C were combined with map unit 32B that is similar except for slope). Some map units of small areas were combined with similar map units named after a different series. Six of these map units were combined with a map unit for which the major component of the lesser unit was identified as an inclusion in the more extensive map unit (e.g., map unit 67B, Morris channery loam, has a 10 percent inclusion of Norwich channery loam). The two very small acreage map units of Allegheny, 2B and 134B, were cartographically combined with dissimilar but geographically contiguous map delineations.

Other changes to the legend involved the correlation of taxonomic units whereby a different soil series was determined to better represent the soil (e.g. map unit 27A, Chewacla was changed to Codorus). A draft legend was printed from the data file and the participants examined it for discrepancies.

Map Unit and Soil Component Attributes –

Data for soil map unit transects were entered into a computer data file prior to the workshop. Transects were identified by watershed number, soil map symbol and transect number. The transect number corresponded to the number assigned to each available transect (one or more for each delineation) for a map unit in a watershed. For each of the ten equally spaced stops along the transect, the soil name, slope gradient, and additional notes were entered into the data file. Workshop participants used these data, field notes, and knowledge gained from observations during the field mapping to adjust map unit composition. The proportion of major and minor soils and miscellaneous area components in each map unit was estimated to the nearest five percent.

Corrections to map unit composition were recorded on map unit worksheets (Figure 2-1, Appendix A) that had been generated from the mapping data management system before the workshop. The corrections were entered into the data file, checked for completeness and reviewed again during the workshop. Every map unit component identified in the map unit composition file was assigned a code and each of these soils or miscellaneous areas was listed in the soil component file along with selected soil characteristics and taxonomic classification. Soil properties recorded in this file along with the soil name were texture, slope, permeability, drainage, mode of deposition, origin of parent material, depth to bedrock, and depth to a slowly permeable or impermeable layer. The initial soil component file resulted from data entered for major components of map units in the preliminary legend and those added during the mapping. Soil components not used in the composition file were deleted from the components file. Components were added during the workshop using the mapping data management system and a print-out of the file was examined for completeness and discrepancies.

The taxonomic classification of each soil series was checked against the SCS National Soil Series Classification List or the most recent copy of the SCS Official Series Description. The information in this file was used to sort soil components into soil sampling classes developed during the sampling class segment of the workshop.

Selected landscape attributes of map units were recorded in the map unit file. These included regional landform, local landform, geomorphic position, slope shape across and slope shape down. A print-out of these attributes along with the map symbol and map unit name was reviewed and corrected or completed as necessary by soil scientists from the state responsible for the map unit. Corrections and additions were entered into the data file and the file was again listed and reviewed.

Soil Map Unit Transects --

Following the workshop, a sampling class was assigned to the soil at each stop in the transect file by relating the soil name to the same soil name in the components file and replacing the corresponding sampling class code in the transect file with the sampling class code from the components file. In this manner, misspelled soil name entries and soils not in the components file were identified by missing values in the sampling class field of the transect file. These data were reviewed and corrected on the print-out of the transect file by soil scientists representing each state. Corrections to the computer data file were made and any remaining discrepancies were resolved by the Mapping Task Leader and field soil scientists.

4 QUALITY ASSURANCE AND QUALITY CONTROL ACTIVITIES

PROGRESS FIELD REVIEWS

Progress field reviews were conducted according to the guidelines of the NCSS (SSS, 1979). A form, based on SCS form SCS-SOI-233, was developed to promote a uniform approach to items examined during reviews (Figure 4-1, Appendix A). The completed form was submitted to the Mapping Task Leader at ERL-C.

The mapping activities of each crew were evaluated and the following items were checked: adherence to protocols, base maps, map symbols, correspondence between soils and depth-to-bedrock mapping, documentation of soil taxonomic units, soil map units, pedon descriptions, general notes, soil transects, map delineation boundaries, and choice of map units. In addition, the reviewer conducted a randomly chosen traverse of the watershed to determine whether the mapping was correct.

Results of the Progress Field Reviews by the SCS State Staffs

The SCS State Soils Staffs involved in this project were responsible to conduct at least one field review of each mapping crew. Field reviews were conducted by the SCS State Soils Staffs of PA and WV. Each mapping party was evaluated once by the SCS and the reviews are listed in Table 4-1. No mapping was rejected by the reviewers and no major problems were identified during the SCS field reviews. Most commonly discussed was the choice between several similar map units, the size of delineations, changes to slope classes, the addition of soil map units to the legend, and minor changes in vegetation mapping. Minor cartographic mistakes were also found during the field reviews. The naming of map units (such as consociation vs complex) was discussed. There was one instance in which an area had been designated with a short-steep-slope symbol but the reviewer thought that it should be a separate map delineation. Field reviews were useful in the opinions of the field personnel for clarifying aspects of the protocols. During one review the soil scientists indicated that a landowner in Fulton Run watershed refused the mappers access to the owner's property, but the crew leader felt that the kind of soil could be inferred from surrounding property. The report of the review indicated that all of the soils and vegetation were identified correctly.

Table 4-1 Field Reviews Conducted by the SCS

Watershed ID	Watershed Name	State	Date
1D029031	E. Branch Wallis Run	PA	06/20/88
2B036028	Boyers Run	PA	06/27/88
2B041008	Piney Creek	PA	07/18/88
2C028069	Whitney Run	PA	07/27/88
2C029016	E. Branch Big Run	PA	07/14/88
2C041002	Fulton Run	PA	07/18/88
2C041040	Thunderstruck Creek	WV	06/01/88
2C047007	Crawford Run	WV	05/18/88

Results of the Progress Field Reviews by the RCC

The QA plan (Appendix C) specifies that the RCC should participate in at least one field review of a watershed for each State Soils Staff's region of responsibility. The RCC conducted two progress field reviews; both were conducted in conjunction with the SCS State Soils Staffs. These reviews are listed in Table 4-2 and discussed in more detail in the final report of the RCC included as Appendix D.

Table 4-2 Field Reviews Conducted by the RCC

Watershed ID	Watershed Name	State	Date
1D029031	East Branch Wallis Run	PA	06/20-21/88
2C041040	Thunderstruck Creek	WV	06/01/88

The RCC did not reject any of the mapping. Deficiencies noted during the reviews included an area that the mappers named very channery but had less than 35 percent rock fragments in the surface; Udifluvents that had been incorrectly labelled Fluvaquentic Dystrochrepts; an area mapped as sugar maple forest cover which had codominant American Beech, and yellow birch; and small areas of differing soil that should have been delineated. The RCC thought that there were particularly excellent field notes for one watershed. The reviews by the RCC facilitated better communication among states to effect the consistency of the mapping and improve correlation of the soil taxonomic and map units.

INDEPENDENT EVALUATION BY THE RCC

Procedures for Map Evaluation

The RCC independently evaluated 20 percent of the watersheds in the survey. The evaluations are described in more detail in Appendix D. Mapping was evaluated by examination of stereoscopic pairs of aerial photographs. Relationships between soils and landforms were scrutinized and areas were identified that required closer examination by traversing and transecting.

Map correctness was judged by how well the map unit descriptions fit the soils in the mapped areas, and how accurately map unit boundaries were drafted on the maps. For this survey, the following mappable soil features were selected as most important;

- depth-to-bedrock or impermeable layer,
- drainage class,
- family particle-size class,
- slope, and
- rockiness class.

Consistent decisions about the acceptability of soil maps are based on predetermined allowable differences. There are two criteria for soil maps that must be evaluated to determine if mapping is acceptable:

- the degree of variance from the expected for each error, and
- the number of errors.

The degree of variance for the most important soil features can be measured by class intervals. For example, if the reviewer expects the area to be mapped as well drained, then a value of moderately well drained varies from the expected by 1 class, whereas poorly drained varies from the expected by 3 classes. Acceptable mapping can be evaluated by use of the relationship between the number of errors and the degree of variation. Table 4-3 lists the number of errors in each 130 ha (320 acre) area for mapping to be judged unacceptable. For example, a watershed with an area of 640 acres must have fewer than 4 errors that differ from the expected particle-size class by 2 class intervals to be acceptable. These standards were used as a guide to judge mapping acceptability at the discretion of the RCC.

Mapping Evaluation by the RCC

The Mapping Task Leader selected the map units for transecting by the RCC. The watersheds evaluated by the RCC are listed in Table 4-4. The RCC also examined both transects that he chose and areas that were traversed while going to or coming from the transects. The goal was to evaluate 20 to 50 percent of the map delineations in the selected watersheds. The watershed boundary, soil, landuse and forest cover mapping were evaluated. The depth-to-bedrock mapping was not evaluated separately because it is based on the soil mapping. It is difficult to field check depth-to-bedrock classes greater than two meters unless there are numerous road cuts or artificial excavations.

The RCC requested that a soil map be redrafted because areas of alluvial soils were not mapped and were greater than two acres. Discrepancies and comments resulting from the evaluations included a map unit complex that should have been a consociation, consociations that should have been complexes, soils that were taxadjuncts to named series, the need to add some stony or bouldery map units to the legend, incorrect slope classes, hydric soils greater than 2 acres that should have

Table 4-3 Map Acceptability Criteria

Soil Characteristic	Number of Classes from Expected	Number of Errors* for Unacceptable Rating
Depth-to-bedrock or impermeable layer	1	5
	2	2
	3	1
Drainage Class	1	5
	2	2
	3	1
Particle-size class	1	8
	2	2
	3	1
Slope	1	8
	2	5
	3	1
Stoniness, boulderiness	1	10
	2	5
	3	2

* per 130 ha (320 acres)

Table 4-4 Independent Evaluations Conducted by the RCC

Watershed ID	Watershed Name	State	Date
1DO36017	No Name	PA	09/12-15/88
2B41008	Piney Creek	PA	08/29-09/01/88
2B047089	Moormans River	VA	08/03-07/88
2C029002	Upper Dry Hollow	PA	09/19-22/88
2CO29020	Wolf Run	PA	09/24-27/88
2C041002	Fulton Run	PA	09/09/88
2C041039	Buffalo Creek	WV	08/15-17/88
2C041045	Right Fork Clover Run	WV	08/10-12/88

been mapped, and some areas of mineral soil near watershed boundaries less than 6 acres that should not have been mapped. All eight watersheds were judged as acceptable after revision. The report by the RCC summarizing his activities and findings is included as Appendix D.

EVALUATION OF SOIL TRANSECT DATA

Transect Data

Transects consisting of ten observations of the soil at equally spaced intervals across a map unit delineation were conducted by field soil scientists during the mapping and by the RCC during evaluation of the mapping. The transects conducted by the field soil scientists, referred to as routine transects, were used in estimating the relative composition of map unit components in a map unit. This approach resulted in a total of 351 routine transects of which 348 were used for analysis. Of the 195 map units in the survey area, 37 (19 percent) had 3 transects or more, 40 (20 percent) had 2 transects, 92 (48 percent) had one transect and 26 (13 percent) were not transected.

Transects conducted by the RCC were used to evaluate the correctness of map unit composition that was estimated during the mapping and correlation which was based on field observation and transect data. The RCC conducted transects in the watersheds that were selected for mapping evaluation. Map units selected for transecting by the RCC had three or more routine transects. The RCC conducted 61 transects in 24 different map units.

Analyses of Soil Transect Data

The RCC transect data were used to evaluate the correctness of the described map units. The routine transects do not provide an independent evaluation of the accuracy of the proportions of soil components, because the information from the routine transects was used in the soil correlation workshop to adjust the proportions of map unit components in the map unit composition database. However, the routine transects do provide a means to evaluate whether the delineations within the same map symbol are alike in proportion of components.

The proportions of soils transected by the RCC were compared to the expected proportions in the map unit composition database to determine if there were any significantly differences. Also, routine transects were compared to RCC transects. Finally, soil components observed at transect points were assigned to the appropriate sampling class, and map unit correctness was evaluated with respect to the sampling class composition. The latter evaluation was especially relevant in judging the correctness of map units for the purposes of DDRP. All statistical tests were conducted using two-sided alternative hypotheses. The names of the map units in the following discussion are found in Appendix B with the corresponding ID numbers.

Analysis of the Map Units by Major Components --

Major components, those comprising 20 percent or more of the map unit, were determined from the map unit composition database. For the major components of each map unit, the transect points were treated as observations from a binomial distribution with the population proportion p, where p was calculated from the map unit composition database. The binomial distribution was used because the outcome of each transect can be classified in exactly 1 of 2 ways; either the proportion of a particular major map unit component matches the expected result from the map unit composition database or not. The sample proportion used was the total number of transect points with the same name as a major component, divided by the total number of transect points. If n, the number of transect points, was over 25 and the expected proportion p (i.e., the total proportion of named components in the map unit, as estimated by the soil scientists and rounded to 5 percent increments) was not too close to zero or one, [i.e., $np > 5$ and $n(1-p) > 5$], then the normal approximation to the binomial was used. If one of these three conditions was not met, then the hypothesis test was computed directly from the binomial distribution.

A statistical analysis using only the binomial distribution can be produced from tables of the cumulative distribution function of the binomial. Assume that B(x) is the probability that a binomial with parameters n and p will be less than or equal to the constant x. Thus we can calculate B(x-1) [the probability of a lower value] and 1 - B(x) [the probability of a higher value] using x, the number of matching observations. If either of these values is less than half of the assumed level of significance, then the null hypothesis (that x comes from a binomial distribution with the specified p) is rejected.

For the 348 routine transects used in the analysis, hypothesis tests were performed at the .05 level of significance to locate transects that had proportions of major components that were significantly different from the expected proportions.

There were twenty-eight routine transects with proportions significantly different from the expected (Table 4-5). Under the null hypothesis of no discrepancies, five percent, or roughly seventeen transects, would be expected to be different. This statistical evidence suggests that the composition as determined by transects does not agree with the expected proportion of major components in all cases.

Five transects that appear on Table 4-5 have the expected proportion equalling one. In these cases, whenever the routine proportion is anything less than one, the transects were flagged as significantly different. This is because an expected proportion of an inclusion probability ever appearing is one and is equivalent to a probability of zero. Five other transects (2 - 31A's, the 67B, the 98B, and the 135E map unit) appear because the selected transects were made on small areas that were correlated into the designated map unit. In each case, the soils were similar enough for

Table 4-5 Significantly Different Map Unit Composition from Routine Transects for Major Components vs. Expected: by Individual Transect

MAP UNIT	WATERSHED	TRANSECT NUMBER	ROUTINE PROPORTION	DATABASE * PROPORTION	SIGNIFICANCE LEVEL
6B	1D2-943	1	0.9	1.00	0.0000
14D	2C4-707	1	0.5	0.85	0.0197
31A	2C4-145	1X	0.0	0.85	0.0000
31A	2C4-633	1X	0.3	0.85	0.0002
41B	2C4-641	1	0.5	0.90	0.0032
41B	2C4-707	2A	0.6	0.90	0.0250
41B	2C4-707	2B	0.6	0.90	0.0250
45B	2B3-628	1	1.0	0.65	0.0269
45B	2C2-916	1	1.0	0.65	0.0269
45B	2C4-102	1	1.0	0.65	0.0269
45C	2B3-628	1	1.0	0.65	0.0414
45C	2C3-527	3	0.1	0.65	0.0010
46B	1D3-611	2	1.0	0.65	0.0269
46B	2C2-920	X	0.2	0.65	0.0096
65C	1D3-617	1	1.0	0.65	0.0269
65C	2B3-646	1	1.0	0.65	0.0269
65D	2B3-646	3	1.0	0.65	0.0269
65D	2B3-662	3	1.0	0.65	0.0269
67B	1D2-942	X	0.0	0.70	0.0000
84C	2C4-634	2	0.4	0.90	0.0002
90A	2B3-662	3	0.6	0.90	0.0255
98B	2C2-902	2X	0.0	0.95	0.0000
109A	2C4-710	1	0.7	1.00	0.0000
128F	2C5-704	2	0.8	1.00	0.0000
130F	2C4-641	2	0.3	0.75	0.0070
135E	2C4-707	2	0.5	0.90	0.0032
151B	1D2-923	7	0.8	1.00	0.0000
151C	1D2-923	4	0.7	1.00	0.0000

* Database proportion is the expected proportion from the map unit database

correlation purposes, but the soils were not renamed in the database and thus showed up in the analysis. A number of other transects had routine proportions that consistently disagreed with the expected proportion in the map unit database. The routine proportions for 41B (Gilpin) were consistently low, and the proportions of three out of four transects were significantly lower than expected. The routine proportions for 45B (Hazleton) were consistently higher than expected from the database. Other Hazleton soils with steeper slopes did not have significantly different transects. These soils had higher expected proportions of major components in the database. Similarly, the map units 65C and 65D (Meckesville) had proportions consistently higher than expected, and other Meckesville soils with higher expected proportions of major components in the database did not have significantly different individual transects. This suggests that this map unit may have more Meckesville soil and fewer inclusions than described in the map unit composition database.

After excluding significant individual transects, the variability in proportion of major components between transects was calculated. This was done to determine if some soils not distinguished by the previous analysis were highly variable in their proportions of major components. The variance of these proportions was calculated for each map unit with more than one transect. Since the distribution of these variances was asymmetric, a robust data analysis technique was used.

A boxplot of the variances of proportions was drawn. Boxplots use the interquartile range (IQR). This is the distance between the first and third quartiles, that is, the 25th and 75th percentiles respectively. Points more than 1.5 times the IQR away from the closest quartile are considered outliers, and points more than 3 times the IQR away from the closest quartile are considered strong outliers. No map units had variances of proportions that would be considered outliers or strong outliers. This suggests that most of the potential problems were already detected by analyzing the individual transects.

Similarly, the RCC transects were examined for transects with significantly different proportions at the 0.05 level of significance (Table 4-6). There were six transects out of 62 that were found to have significantly different proportions. Under the null hypothesis, an average about three transects would have been expected. The two significantly different transects for 46B are above and below the database proportion, which may reflect the variability of this map unit across the region. The map unit

65C also had significantly different routine transects which may suggest that the map unit composition database estimate may be low. The other transects in Table 4-6 had extremely low proportions because the RCC named the observations as different but not different series.

Table 4-6 Significantly Different Map Unit Composition from RCC Transects for Major Components vs. Expected: by Individual Transect

MAP UNIT	WATERSHED ID	TRANSECT NUMBER	RCC PROPORTION	DATABASE PROPORTION	SIGNIFICANCE LEVEL
19E	1D036017	1	0.0	0.85	0.0000
36C	2B041008	2	0.2	0.70	0.0032
45C	2B041008	1	0.2	0.65	0.0096
46B	1D036017	6	1.0	0.65	0.0269
46B	2C029020	4	0.2	0.65	0.0096
65C	1D036017	8	1.0	0.65	0.0269

The RCC transects were also examined for proportion of major components in map units across all RCC transects. The significant individual transects were removed first using 0.05 as the level of significance. Only two map units were found to be significantly different (Table 4-7). The number of transects expected under the null hypothesis of no discrepancies is approximately one or two.

Table 4-7 Significantly Different Map Unit Composition from RCC Transects for Major Components vs. Expected: by Map Unit

MAP UNIT	RCC PROPORTION	DATABASE PROPORTION	SIGNIFICANCE LEVEL
13C	0.5667	0.80	0.0014
46E	0.8605	0.70	0.0217

Comparison of the Routine and RCC Transects --

For these comparisons, the standard two-sample test for a difference in proportions using the normal approximation was used whenever the previously mentioned criteria were met for both samples.

When either sample was not appropriate for a normal approximation, Fisher's exact test was used.

Fisher's exact test (Fisher, 1935) is also known as the Fisher-Irwin test. Assume that a pair of binomial distributions with equal parameters, p, exist. The numbers of successes and failures can be arranged from each sample into a 2 by 2 table. The conditional distribution given the marginal totals is a hypergeometric distribution which is independent of the parameter p. The probability of a lower or a higher number of "yes" responses can be calculated from the hypergeometric distribution, and the null hypothesis of equal proportions can be rejected if either of these probabilities is too small (less than half of the level of significance)..

One map unit was found to have a significantly different proportion from the database, as shown in Table 4-8. Notice that the significant map unit, 29B, was not found to have significant transects for either the routine soil scientists or the RCC. The two proportions come out as significantly different because the routine proportion is slightly above proportion calculated from the RCC transects, while the RCC proportion is slightly below the expected proportion. The expected number of significant map units under the null hypothesis is also one. This strong agreement suggests that the routine mapping produced results that were not observably different from that done by the RCC. The routine and RCC transects seem to reflect the soil variability across the region because they are slightly higher and lower than the map unit composition database estimates.

Table 4-8 Significantly Different Map Unit Composition Routine vs. RCC Transects by Map Unit

MAP UNIT	RCC PROPORTION	RCC COUNT	ROUTINE PROPORTION	ROUTINE COUNT	SIGNIFICANCE LEVEL
29B	0.700	40	0.900	30	0.0138

Analysis of the Map Units by Sampling Class --

The DDRP grouped soils together for analyses that have similar properties that affect their interaction with acidic deposition. The sampling classes for this survey are shown in Figure 4-1. Since there were several hypothesis tests for each map unit, the Bonferroni inequality was used to handle the error rate of the simultaneous hypothesis tests within each map unit. For a set of m simultaneous hypothesis tests on each map unit, we could assign an individual significance level equal to 0.05/m, so that the overall level of significance for the map unit would be at most 0.05. This was a conservative approach, but the simplest to program and implement. Also, significantly different individual transects were removed prior to the analysis.

After removing significant individual transects, the RCC transects were analyzed for significant sampling classes within map units. There were three different map units with sampling classes that differed significantly from the proportions estimated by the soil scientists (see Table 4-9). At the 0.05 significance level we would actually expect one or two map units with significant sampling classes under the null hypothesis. The three map units observed is not an unusual occurrence. The probability under the null hypothesis of observing three or more map units is approximately 13 percent, so this is not an unusual event under the null hypothesis. Note that one of the map units listed is 41E, a Gilpin soil that, as observed earlier, had some routine transects that were significantly lower in Gilpin composition that the map unit composition database.

Table 4-9 Significantly Different Map Unit Composition from RCC Transects vs. Expected for Map Unit and Sampling Class

MAP UNIT	SAMPLING CLASS	RCC PROPORTION	EXPECTED PROPORTION	NUMBER OF OBS.	SIGNIFICANCE LEVEL
13C	BMK	0.50	0.80	30	0.0000
13C	BNS	0.33	0.10	30	0.0009
19E	BMK	0.63	0.85	30	0.0059
41E	TWM	0.70	0.95	10	0.0230

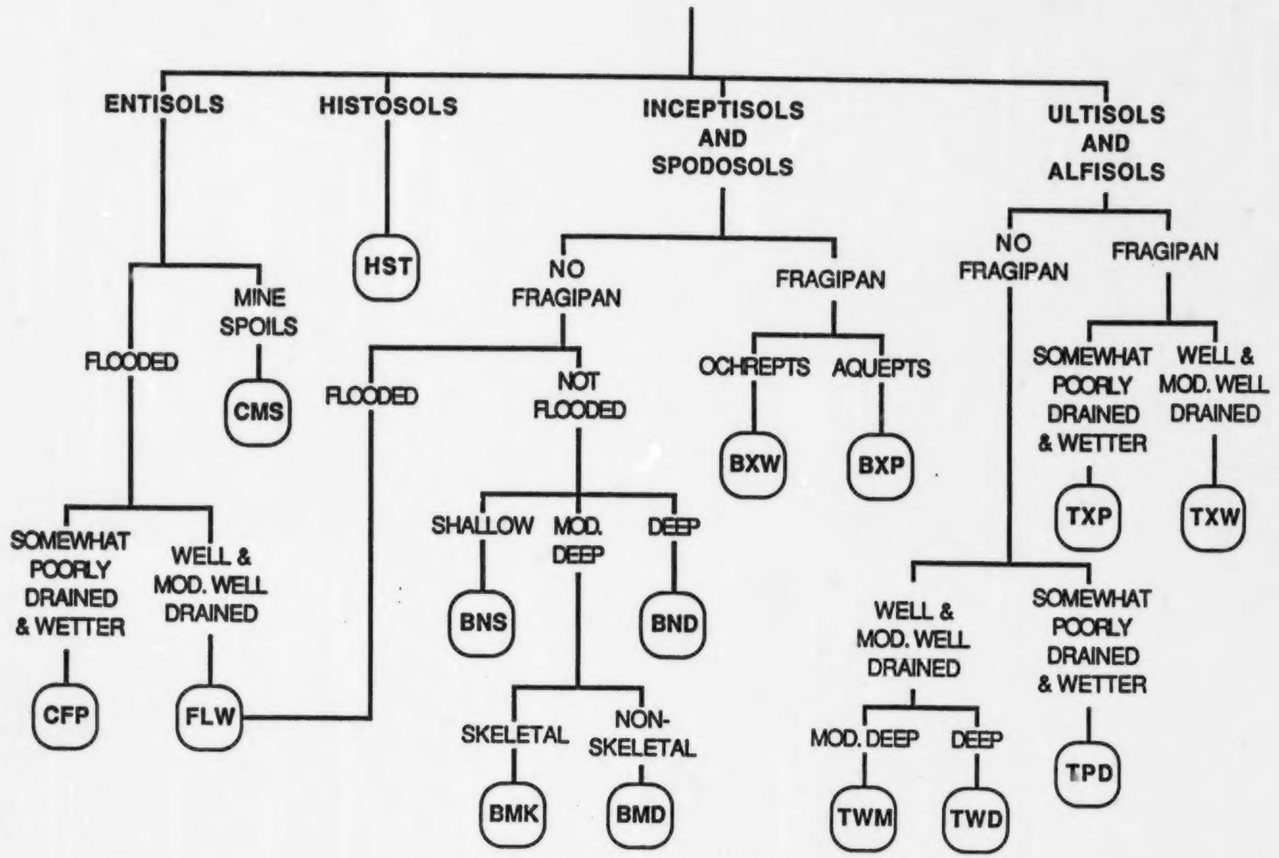

Figure 4-1 DDRP Sampling Classes for the Mid-Appalachian Region

After removing significantly different individual transects, the routine transects were also analyzed for significant sampling classes within map units. Out of 170 map units analyzed, only eight had significant sampling class proportions (Table 4-10). Under the null hypothesis, about 8 or 9 map units would be expected. This agreement suggests that for the most part, the sampling classes for the map units are not noticeably different from their expected proportions. Hazleton map units (46B, 46C, 46D and 46E) may have 10 to 15 percent more of sampling class BND than listed in the database, based on the transect data.

Table 4-10 Significantly Different Map Unit Composition from Routine Transects vs. Expected for Map Unit and Sampling Class

MAP UNIT	SAMPLING CLASS	ROUTINE PROPORTION	EXPECTED PROPORTION	NUMBER OF OBS.	SIGNIFICANCE LEVEL
18B	TXP	0.01	0.15	80	0.0006
46C	BND	0.93	0.75	60	0.0010
46D	BMK	0.02	0.10	100	0.0077
46D	BND	0.87	0.75	100	0.0056
46E	BND	0.90	0.75	70	0.0038
53C	BMK	0.40	0.05	10	0.0021
62C	BMK	0.93	1.00	29	0.0000
62E	BMK	0.90	1.00	30	0.0000
161D	TWD	0.90	0.40	10	0.0034

Conclusions

The transect analyses suggest that the only noticeable problems with the estimated map unit composition may be for Gilpin, Hazleton and Meckesville soils. After removing significant transects, no map units had unusually high variability. After the significant transects were removed, the map units were very consistent. The sampling classes matched the expected proportions well, indicating that there were few problems in the mapping as far as the use by the DDRP project was concerned. Some of the Hazleton soils (46B, 46C, 46D and 46E) had slightly more sampling class BND than listed in the database. This is inconclusive because the number of transects may not be sufficient to be representative of the map units.

EXIT MEETING

An exit meeting was held to review mapping operations and to document mapping operations. Differences in interpretation of protocols by individuals and the need to make on-the-spot decisions during field operations has been recognized by project scientists. These activities may affect the quality of the mapping or the interpretations applied to the mapping data. A review of mapping operations pointed out some weaknesses in mapping protocols, training, and communication; and helped to evaluate mapping quality and reliability of assessment results. The review was conducted by soliciting responses to a questionnaire from SCS soil scientists representing the states responsible for the mapping, the Mapping Task Leader, and the RCC.

Recommendations from the Exit Meeting

The following is a summary of the recommendations made by the participants of the exit meeting:

- It would have been beneficial to have had the DDRP project more fully explained to them so that they could have known what special properties to document in field notes. There were several presentations made to the soil scientists at the time of the correlation meeting but not all of the field soil scientists were present.
- It was suggested that more explicit initial instructions about transects should have been given to the soil scientists because it was unclear whether the series or taxonomic name was to be written on the transect forms.
- Mapping crews should each map one watershed in its entirety, including drafting final map overlays, and then all meet to discuss any questions or problems. This would facilitate any changes or clarifications to the protocols and notify all the parties of any changes.
- Transects oriented perpendicular to ridgelines may not always be best. If the map unit is very narrow the transect would go directly uphill rather than diagonally across slope. Some transects zig-zagged because of narrow delineations. It was recommended that it be left to the discretion of the field scientist where to locate transects.
- The use of color-infrared and black-and-white photography was very helpful but the orientation of the flightlines should be more strictly controlled. Photography with cloud-cover should be avoided.
- Additional landuse codes should be developed. There should be more choices to describe open land other than pasture, such as brushy land (overgrown fields), clearcuts, and haylands. Land that is in rotation, such as hayland-pasture, was difficult to map. There needs to be a landuse/cover type for tree plantations.

- The field review forms and reports should be sent to the RCC, as well as the Mapping Task Leader, within two weeks to allow the RCC to make a timely evaluation. In this survey, the RCC evaluated the field reviews after the mapping was complete which made the RCC assessment less useful.

- The RCC recommended that the soil mapping should be drafted first on aerial photographs. These photographs would then be retained to facilitate map evaluation. This would make it easier for reviewers because they would have reference points to orient the mapping. It would have also made it easier to orient the maps if they were photocopied overlaying a topographic base.

- The DDRP QA Coordinator from ERL-C, who used the field notes to help resolve map discrepancies, recommended that a standard logbook should be developed to record field notes. This would ensure that all of the watersheds are described in the same level of detail and that the same types of observations are recorded. Items that should be described include:

    - Amount of Human Activity including excavations, pits, roads, number of houses, camps, and agricultural activity.

    - Potential contamination such as septic tank or sewage contamination, application of chemicals to control algae or fungus in lakes, and heavy recreational use.

    - Watershed boundary information such as why watershed boundaries were changed from EPA supplied delineations and any special situations affecting watershed boundaries, such as diversion ditches.

    - Streams, evidence for classifying streams intermittent or perennial.

EVALUATION OF FINAL MAPS AND WRITTEN DOCUMENTATION BY SOIL SCIENTISTS

The final maps and written documentation were evaluated by ERL-C soil scientists prior to digitization of the maps. Digitizing map data and correcting digitized data are time consuming tasks which make it critical that data be correct before digitizing takes place. Apparent discrepancies were resolved directly with the soil scientists and the SCS State Soils Staffs. Apparent discrepancies and situations requiring more information included watershed boundaries, depth-to-bedrock mapping compared to soils mapping, insufficient written documentation, missing or smudged map unit labels, stream placement, and potential water contamination.

Tic marks were sometimes imprecisely drafted on maps and geographers at ERL-C redrafted them. Discrepancies were resolved and the maps were digitized. The soil scientists were contacted when there was some question about whether streams were perennial or annual. The watersheds were mapped in a dry year, so local residents were consulted about streamflow in normal years.

Landowners confirmed that some fairly large watersheds had intermittent streams. There were some minor cartographic mistakes, such as drafting gravel pit symbols rather than mine symbols and not combining adjacent units with the same symbol.

Watershed Boundaries

Delineating correct watershed boundaries is very important because the characteristics within those boundaries are used to relate to the water chemistry sampled by the NSWS. Thus, the watershed boundary must include only the land area that contributes to surface flow of water to the stream above the sampling point of the NSWS. Soil scientists were provided with copies of topographic maps with watershed boundaries delineated by the NSWS based on the location of the water sampling point and the topography as inferred from the topographic map. Sixteen departures from the NSWS boundaries are listed in Table 4-11 with the reason for the change. Table 4-11 reflects the changes resulting from the ERL-C soil scientists' and the geographers' (described below) evaluations.

Wetlands are often on gentle relief and it may be hard to determine the direction of water flow from maps or aerial photographs. Streams may have changed their channels since topographic maps were made. Older topographic maps are often 15 minute quadrangles (1:64,000 scale) which may not be detailed enough for this study and tend to get distorted when enlarged to 1:24,000 scale. There were cases where water diversions, ditches, and construction had changed the direction of surface water flow from what the topographic maps or aerial photographs show. There is a diversion built 50-60 years ago that takes approximately 20 percent of the peak flow from Jeans Run (1D037005).

Potential Contamination

Table 4-12 lists the watersheds that may have some potential contamination to water quality other than acidic precipitation. None of the watersheds were excluded from sampling because of the potential contamination.

Table 4-11 **Watershed Boundary Changes**

ID	Watershed	State	Comments
1D029043	Bowman Creek	PA	Boundary changed because drainage is not as topographic maps shows. Beech Lake only flows northeast during very high water and is hindered from doing so by a roadway that acts like a dam.
1D037005	Jeans Run	PA	Slight difference.
2B036046	Lower Little Swatara	PA	Small change in boundary near outlet.
2B047032	Elk Run	WV	The SCS did not extend the mapping all the way to the outlet of stream.
2B047036	Bible Run	VA	Two minor changes.
2C028069	Whitney Run	PA	Follows NSWS except extended below downstream sampling point
2C028075	Bear Run	PA	Slight difference.
2C029016	East Branch Big Run	PA	Slight changes made to the SCS boundary and the SCS boundary did not extend to the NSWS downstream sampling point.
2C029020	Wolf Run	PA	SCS made minor changes to the boundary,
2C035027	Williams Run	PA	SCS mapping didn't extend to NSWS downstream sampling point.
2C041002	Fulton Run	PA	Mining in the upper reach forms the new boundary. SCS mapped too far downstream at outlet.
2C041051	Coal Run	WV	SCS added slightly more area, USGS made an error at the intersection of two streams.
2C046033	Johnson Run	WV	A small micro-watershed was excluded at west portion of the outlet.
2C046041	No Name	WV	SCS mapped below the NSWS downstream sampling point.
2C046050	Hendricks Creek	WV	Lower reach of stream is cut off by a highway.
2C047010	Clubhouse Run	WV	A railroad ditch altered drainage.

Table 4-12 Watersheds With Potential Contamination

ID	Watershed	State	Comments
2B047032	Elk Run	WV	The network of US Forest Service roads are surfaced with limestone gravel. There is a small garbage dump at the north end of the watershed but it is near the ridge, far from the main stream.
2B047036	Bible Run	VA	Some land application and dumping of poultry manure.
2C029016	East Branch Big Run	PA	A state highway crosses the upper reach of the watershed.
2C029020	Wolf Run	PA	There were 13 gas wells in the watershed and more were in the process of being drilled. Also numerous access roads.
2C041002	Fulton Run	PA	Two mine shafts have water discharge that may affect stream chemistry.
2C041039	Buffalo Creek	WV	Seepage from a gas transmission line pump station into stream. The station reportedly burns sulfur from gas, and a strong smell of sulfur was observed.
2C041045	Right Fork Clover Run	WV	A state highway follows the entire length of the main stem of the stream.
2C046041	No Name	WV	There are highways and houses on the east and north watershed boundary and housing in the southern portion of the watershed.
2C046050	Hendricks Creek	WV	Highway crosses creek, may be some contamination from road salt in winter.
2C057004	Butler Branch	WV	The NSWS downstream sampling point is in an area with a surface mine.

Depth-to-Bedrock Mapping

The depth to bedrock mapping was easily checked because the classes were supposed to match the soil depth of the major soil of the map units. The depth-to-bedrock maps were overlayed on the soils maps for evaluation. The most common discrepancy was that multiple classes for soil complexes did not have the symbols listed in order of abundance. There were several instances where the soil scientist drafting the depth-to-bedrock map did not realize that it must match the soil map. It might have been useful to have generated depth-to-bedrock maps at ERL-C based on the digitized soil maps and the soil depth from the mapping database.

Field Notes

The soil scientists were asked to record observations about soil and watershed characteristics in addition to the profile descriptions and transect information. There was no standard format or guidelines given to the soil scientists. The notes were intended to provide additional information about soil morphology, geomorphology, special landuse, and cases of suspected contamination to soil or water.

The notes were generally brief and without much detail. The length of each set of notes ranged from a few sentences to two pages. The notes commonly discussed landuse, vegetation, land ownership, possible contamination, beaver activity, watershed boundary information, soil morphology, and contrasting inclusions. Some short profile descriptions on notecards were included with the notes. Field notes were sometimes written as comments on the transect forms rather than in a separate report.

EVALUATION OF FINAL MAPS AND WRITTEN DOCUMENTATION BY GEOGRAPHERS

Final Map Analysis and Data Entry

A series of procedures, guidelines, and protocols were initiated to reduce the uncertainty of mapped data entered into a GIS. Central to this approach was the use of formalized log sheets to record the steps necessary to validate and digitize mapped data. The use of log sheets during the digitization process served several purposes. First, each technician was required to sign and date the log sheet following successful completion of each step ensuring consistency and accountability. Secondly, the signed log sheet became part of the permanent record of the project and, therefore, provided key documentation. Finally, because the log sheets identified a responsible party, it was possible to backtrack when systematic errors or problems were discovered. In addition to log sheets, accuracy and precision of the mapping products were formally evaluated at various stages. At critical stages, the evaluations were independently repeated by a second technician.

In addition to the SCS mapping products, the DDRP also obtained aerial photograph information on land use/land cover, wetlands, and streams from the USEPA's Environmental Monitoring and Systems Laboratory (EMSL-LV) in Las Vegas, Nevada. Although this document focuses on SCS mapping procedures and products, EMSL mapping was used during final map analysis and GIS data entry as an independent check on the accuracy and consistency of watershed mapping.

Pre-Digitization Procedures

Prior to data entry (digitization), the source maps were checked for consistency, accuracy, and completeness. The source maps were then adjusted or corrected prior to automation. Formalized log sheets were used to validate these procedures (Figure 4-2).

Watershed Delineation –

Watersheds were first delineated based on contour crenulations on 1:24,000 or 1:62,500 topographic maps. The watershed delineations were then sent to the SCS and EMSL-LV for mapping. During mapping, individual soil scientists sometimes changed the predetermined topographic delineation based on ancillary evidence derived from aerial photographs or field information. These subjective changes were particularly evident in the low-lying wetland areas and in areas that were only covered by older and less accurate 1:62,500 topographic maps. There were potentially three different watershed delineations: the preliminary estimate of the watershed delineation based on topographic maps, the field delineation, and the photo-interpreted delineation. First, the field mapped delineation was checked following the topographic delineation. Next, all delineations were compared for

DDRP SOIL SURVEY
MAP CHECKING CHECKLIST
GEOGRAPHIC RESEARCH

Watershed ID__________________ Watershed Name, County______________________________
State__________________________
Name(s) of Reviewers____ Date____________
Mappers____
Date Mapped____________

1. Have all the map overlays arrived at ERL-C?
SCS
_____soils _____veg _____geo _____dep _____drainage _____transects

Photointerpretation
_____landuse _____detailed wetlands _____drainage

2. Are tic marks present and accurate?

DISCUSSION AND RECOMMENDED FOLLOWUP - Registration

3. Are SCS watershed delineations consistent?

4. Do SCS delineations follow NSWS delineations?

5. Do the photointerpreted delineations follow SCS and/or NSWS delineations?

DISCUSSION AND RECOMMENDED FOLLOWUP - Watershed delineations

6. Do SCS streams agree with USGS blue lines?

7. Do SCS delineations follow topographic features?

DISCUSSION AND RECOMMENDED FOLLOWUP - Drainage

Figure 4-2 Log Sheet for Geographers' Map Checking

consistency (e.g., were the same ridgetops followed, was the outlet of the watershed consistently located, etc.). If the mapped delineations followed the topographic delineations and were consistent with each other, the delineation was accepted. If there were large differences between the delineations (e.g., watershed outlet not consistently located, inclusion or exclusion of sub-basins, etc.), it was assumed that the field mapped version was be correct as long as the SCS had a legitimate reason to adjust the boundary. Legitimacy was confirmed by discussing any "problem" areas with the field soil scientists. The EMSL-LV maps were then adjusted or re-mapped to fit the final boundary. The watershed boundary changes are summarized in Table 4-11.

Watershed Consistency --

As described previously, all map layers were first checked for consistency in watershed delineations and corrections were made. A second source of inconsistency was in the definition of water or lake boundaries. Errors within the SCS mapping layers were first identified, problem areas were discussed with SCS, and appropriate corrections made. Two inherent sources of variability, however, could result in different SCS versus EMSL-LV water body delineations. These sources included: (1) differences in mapping resolution of wetlands - EMSL-LV mappers delineated wetlands down to one acre while the SCS used a two acre minimum resolution, and (2) individual mappers produced different water body interpretations due to the limitations of the particular mapping technique (e.g., field versus photo-interpreted). Because of this inherent variability in the delineation of water bodies, absolute reconciliation between SCS and EMSL-LV lake delineations was not attempted.

Mapping Completeness --

All source maps were first visually scanned for completeness (e.g., existence of polygon codes) and obvious errors (e.g., missing line segments). Not much time was spent completing this task because these errors would have been more efficiently identified during subsequent QC procedures.

Mapping Registration --

Registration marks are used to transform digital maps to ground coordinates. Individual map layers were first checked for registration to a topographic map. Next, each individual layer was manually overlaid with other layers and consistency were examined and corrected where appropriate.

Map Unit Registration --

Map unit registration refers to how well the individual map units correlate with topographic and other physical features. To check map unit placement, the mapped information was compared with appropriate topographic maps. First, soil and depth-to-bedrock source maps were manually overlaid onto the topographic map. Next, the location of ridgetop soils were examined relative to topographic ridgetops and valley-bottom soils were examined relative to stream channels. If the mapped features followed the topographic features, map unit registration was accepted. The same general procedures were followed for vegetation as well, although these procedures relied on lowland, riparian, and open vegetation patterns and their correspondence with topographic features. If map unit registration was judged inadequate, the individual map layers (e.g., soil) were re-drawn to better fit topographic features.

Digitization Procedures

QC checks instituted during the digitization process addressed three major goals: digitization consistency, line segment accuracy, and attribute accuracy. As with pre-digitization procedures, the use of formalized log sheets was central to the approach.

Digitization Consistency --

Digitization consistency was ensured by using log sheets and by implementing specific technical guidelines for use in the digitization process. Formalized log sheets were used during both line segment digitization and attribute entry (Figures 4-3 and 4-4, respectively) to ensure consistent data entry, to provide key documentation, and to provide a system of accountability. Two technical guidelines were also used during the digitization process to increase consistency. First, a minimum

DIRECT/DELAYED RESPONSE PROJECT - COVERAGE AUTOMATION LOG

WATERSHED NO.________ DATE_______

		INITIALIZE UPON COMPLETION
1.	$ SET DEF [DDELAY.-----]	
2.	$ ARC	
3.	ARC: ADS LANDDG digitize tics, watershed boundary, all water bodies, and all landuse polygons.	LANDDG_________
4.	ARC: CLEAN LANDDG LANDCN .25	LANDCN_________
5.	ARC: EDITPLOT LANDCN LAND.PLT Check for polygon errors	LAND.PLT_______
6.	ARC: ARCEDIT Make corrections, as needed. Repeat steps 4-6, as needed	LANDCN_________
7.	ARC: COPY LANDCN LANDUSE	LANDUSE________

Figure 4-3 Coverage Automation Log

DIRECT/DELAYED RESPONSE PROJECT - DATA ENTRY LOG

WATERSHED NO.________ DATE_______

```
                                                            INITIALIZE UPON
                                                            COMPLETION

1.    $ SET DEF [DDELAY.-----]

2.    $ COPY [DDELAY]BASE.DAT LAND.DAT

3.    $ VP LAND.DAT                                         LAND.DAT_______
            type in data
            <ctr>z

4.    $ ARC

5.    ARC: INFO
      USER NAME> ARC                                        LANDTAB________
      ENTER COMMAND> ADIR [DDELAY.SKELETON1.INFO]
      ENTER COMMAND> TAKE ARC *
      ENTER COMMAND> SEL LANDTAB
      ENTER COMMAND> ADD FROM [DDELAY.----]LAND.DAT
      ENTER COMMAND> LI - check data
      ENTER COMMAND> Q stop

6.    JOINITEM LANDUSE.PAT LANDTAB LANDUSE.PAT LANDUSE-ID LANDUSE-ID
                                                            LANDUSE.PAT____

7.    ARC: INFO
      USER NAME> ARC
      ENTER COMMAND> SEL LANDUSE.PAT
      ENTER COMMAND> LI - check .PAT file
      ENTER COMMAND> Q STOP
```

Figure 4-4 Data Entry Log

acceptable Residual Mean Square (RMS) error was used during the transformation process. The RMS is the mean of the residuals squared of the tic registration versus the expected values (ESRI, 1987). In general, the minimum acceptable RMS error was 0.003, although higher RMS values were occasionally accepted when using poor quality source maps. Second, a template layer containing the watershed and water body boundaries was digitized using the soils layer as a guide. Line segments and attributes were then added to the template coverage for each of the individual layers. This helped to ensure consistent watershed and water body boundaries for all map layers.

Line Segment Digitization --

The steps used in line segment digitization are listed in Figure 4-2. During digitizing, all line segments were purposely extended as overshoots to create "dangling chains" (Chrisman, 1987). The overshoots were then automatically deleted during the building of topological structure. Following digitization, plots were made using an internal editing feature of the GIS software. These plots depicted polygon errors including: unclosed polygons, unlabelled polygons, or polygons with more than one label point. Identified errors were corrected before continuing. A new plot displaying all digitized line segments and labels was then made at the same scale as the manuscript maps. The plot was overlaid with the manuscript maps on a light table. If any light showed through between the digitized line segment and the drafted line, the line segment was corrected and the polygon error check was repeated.

Attribute Entry --

The steps used in attribute entry are shown in Figure 4-3. First, the attributes for each map unit were entered into an computer text file and visually scanned for obvious errors. Corrections were then made before proceeding to the next step. The text file containing the attributes was loaded into an ARC/INFO database "template" file containing the appropriate item definitions. The template file was merged with the coverage, visually scanned for any obvious errors, and corrected where appropriate. A more thorough evaluation of attribute accuracy was performed following digitization.

Post-Digitization Procedures

Post-digitization QC procedures included checks on coverage accuracy and ground coordinate registration. Coverage accuracy was evaluated through two independent checks of edit plots and by examining the regional consistency and validity of attribute codes. Projection accuracy checks included comparisons within the original data and comparisons between the digitized data and other independent data.

Coverage Accuracy --

Final plots depicting line segments and attributes of each coverage were first generated. These plots were then compared with the original source maps over a light table and checked for accuracy. If any light passed between the digitized line segment and the drafted line, the digitized line segment was corrected to match the drafted line segment, and the necessary QC procedures were repeated. If the line segments were judged to be correct, each individual coverage attribute was then checked against the source map for accuracy and corrected as needed. This entire procedure was performed independently by two individuals. If the coverage was judged to be correct, the individuals were required to sign the plot indicating acceptance. As a final check, attributes for all watersheds were written to a computer file, sorted and independently checked for consistency and validity. This final sorting and checking of the master file helped to identify non-obvious errors such as substitution of the letter "O" with the number "0".

Projection Accuracy --

A series of procedures was used to accurately transform the coverages into ground coordinates, including comparing: (1) "projected" coverages with the source maps (2) EMSL-LV land use and SCS projections, and (3) digitized mapped data with independently obtained data.

First, the coverages were converted into universal transfer Mercator (UTM) coordinates. The projected coverages were then overlaid with the source map and checked for registration and reasonableness of fit. The position of projected watersheds were then compared with coordinates of the appropriate lake as documented by the NSWS. The NSWS point location data represented the lake locations estimated independently from 1:24,000 or 1:62,500 topographic maps. To detect locational errors or any major differences in watershed or lake delineations, the SCS base coverage was then visually compared to the EMSL-LV coverage. Finally, watershed area was calculated and compared for the SCS versus EMSL-LV land use coverages. Watersheds with variations of greater than five percent were flagged and visually re-examined.

5 CONCLUSIONS

CONCLUSIONS FROM THE SCS FIELD REVIEWS

The overall quality of the mapping was found to be acceptable. Only minor deficiencies were identified and subsequently were corrected. The reviews provided opportunities to examine and discuss potential additions to the soils legend. Often the choices between relatively similar map units were discussed during the reviews. The choice between map units to label a delineation is not always clear because soils are a continuum between established series.

Most commonly discussed was the choice between several very similar map units, the size of delineations, changes to slope classes, the addition of soil map units to the legend, and minor changes in vegetation mapping. Minor cartographic mistakes were also found during the field reviews. The naming of map units was discussed, such as naming a soil map unit a consociation rather than a complex.

The RCC reviewed the SCS field review reports and concluded that the reviews had been complete and gave a good indication of the progress of the mapping crews. The reports did not adequately document the percentage of map units that were checked in the field. The RCC concluded that it might have been better for the RCC to have reviewed the SCS field review forms and reports earlier in the project, rather than after the field work was complete.

CONCLUSIONS FROM THE RCC FIELD REVIEWS

The mapping was of acceptable quality. Deficiencies noted during the reviews included an area that the mappers named very channery but had less than 35 percent rock fragments in the surface horizon; Udifluvents had been incorrectly labelled Fluvaquentic Dystrochrepts; an area mapped as sugar maple forest cover that had codominant American Beech and yellow birch; and small areas of a differing soils that should have been delineated. The RCC facilitated better communication among states to effect the consistency of the mapping and improve correlation of the soil taxonomic and map units. More information about the RCC field reviews is presented in Appendix D.

CONCLUSIONS FROM THE RCC INDEPENDENT EVALUATION

The RCC requested that only one soil map be redrafted because areas of alluvial soils greater than two acres were not mapped. Discrepancies and comments resulting from the evaluations included a map unit complex that should have been a consociation, consociations that should have been complexes, soils that were taxadjuncts to named series, the need to add some stony or bouldery map units to the legend, incorrect slope classes, hydric soils greater than 2 acres should have been mapped, and some areas of mineral soil near watershed boundaries less than 6 acres that should not have been mapped. All eight watersheds were judged as acceptable after revision. The report by the RCC that summarizes his activities and findings is included as Appendix D.

CONCLUSIONS FROM THE ANALYSES OF TRANSECT DATA

RCC Evaluation of Transects

The evaluation of transect data by the RCC gives some insight for evaluating the transect data and the conclusions of the RCC are discussed in detail in Appendix D. The RCC concluded that there were 6 transects out of 61 with unacceptable map unit composition compared to the composition database. There were several cases where the RCC transects for a map unit suggested that the units might have been better named complexes rather than consociations. These were minor differences and did not impact the quality of the mapping. The RCC felt that map units with only 1 or 2 transects did not have a large enough sample size to estimate the composition of the map unit. A single transect in a small delineation might sufficiently describe the map unit composition; however, in large delineations a single transect may give an incorrect map unit composition.

Statistical Evaluation of the Transects

The statistical evaluation of the transects showed that the overall quality of the mapping was acceptable. The transect analyses suggest that the only potential problems identified with estimated map unit compositions may be for Gilpin, Hazleton and Meckesville soils. After the few significantly different transects were removed, the map units were very consistent. The sampling classes matched the expected proportions well, indicating that there were few problems in the mapping as far as the use by the DDRP project was concerned. Some of the Hazleton soils (46B, 46C, 46D and 46E) had slightly more sampling class BND than listed in the database. This is inconclusive because the number of transects may not be sufficient to be representative of the map units.

OVERALL CONCLUSIONS

The mapping was found to be of acceptable quality. The completeness goal of mapping 100 percent of the preselected watershed was achieved. The goal for completeness of field documentation was achieved, but the amount and detail of field notes varied greatly. The SCS State Soil Staffs field reviews and map evaluations found no significant problems with the mapping. The RCC's overall conclusion was that the soil scientists did a very thorough and careful job and that, based on 20 percent of the watersheds, the mapping meets the requirements of the DDRP protocols. Statistical analyses of the transect data did not suggest any problem with the mapping and map unit composition estimates.

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APPENDIX A:

DIRECT/DELAYED RESPONSE PROJECT: MAPPING PROTOCOLS FOR THE MID-APPALACHIAN REGION OF THE UNITED STATES

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LIST OF ABBREVIATIONS AND SYMBOLS

DDRP -- Direct/Delayed Response Project
USEPA -- Environmental Protection Agency
ERL-C -- Environmental Research Laboratory-Corvallis
NCSS -- National Cooperative Soil Survey
QA/QC -- Quality Assurance/Quality Control
RCC -- Regional Coordinator/Correlator
SAF -- Society of American Foresters
SCS -- Soil Conservation Service
USGS -- US Geological Survey

1 INTRODUCTION

The mapping protocols are developed to guide personnel involved in the mapping of watersheds selected for study under the Direct/ Delayed Response Project (DDRP). These protocols are directed toward journeyman soil scientists experienced in soil mapping, soil classification, and the natural relationships among soils and landforms. In general, the mapping protocols used by the DDRP follow standard procedures used by the National Cooperative Soil Survey (NCSS) with minor modifications. Readers may refer to the National Soils Handbook (Soil Survey Staff, 1983) and Soil Taxonomy (Soil Survey Staff, 1975) for in-depth understanding of soil mapping principles, detailed descriptions of soil survey procedures and definition of special terminology used in these protocols.

The mapping protocols describe detailed procedures used in the additional activities of the DDRP in the Northeast Region of the United States mapping. The objective is to describe the following:

- the development and control of uniform map unit descriptions and mapping legends,
- the end products of mapping, and
- quality assurance/quality control (QA/QC) for mapping.

The protocols presented in sections 2 through 4 are specific to the DDRP, and are modifications of the procedures used by NCSS.

2 DESCRIPTIVE LEGEND

The descriptive legend is the basic document that governs the conduct of the soil survey and is composed of three parts: descriptions and classification of the soil taxonomic units, identification legend, and conventional and special symbols legend. One descriptive legend describes the soils throughout the region.

DESCRIPTION AND CLASSIFICATION OF THE SOILS

Description and classification of the soils consist of descriptions of taxonomic units (components of map units) as they occur in the survey area. Soil descriptions are referenced to official soil series descriptions with appropriate range in soil characteristics as the soil occurs in the survey area.

Selected characteristics of the soil taxonomic units are recorded in tabular format and entered into a computer database. These characteristics of the components (taxonomic units) of each map unit are also to be listed on the Soil Map Unit Worksheet (Figure 2-1).

Listed below are the characteristics used to describe soil taxonomic units for this project:

- name: series, surface texture phase, slope phase, other phase(s),
- parent Material: mode of deposition, origin,
- depth to bedrock,
- depth to slowly permeable or impermeable layer,
- drainage class,
- permeability,
- hydrologic group, and
- taxonomic classification.

Taxonomic unit descriptions are supported by field note soil descriptions and transect notes. Two field note soil descriptions for each soil (series, etc.) are recorded on a soil pedon description

```
MAP SYMBOL/MAP UNIT NAME
215C/TUNBRIDGE-LYMAN COMPLEX   8-15% SLOPES VERY ROCKY
=========================================================================
 REGIONAL LANDFORM                          LOCAL LANDFORM

 GLACIATED UPLANDS                          HILLSIDE or MTNSIDE
=========================================================================
 GEOMORPHIC POSITION                      SLOPE SHAPE ACROSS   SLOPE SHAPE DOWN

 SUMMIT CRESTED HILLS                     COMPLEX              COMPLEX
=========================================================================
  COMP%     COMPONENTS                    TEXTURE    SLOPE    SMPL CLASS   SCODE

1.  35      LYMAN                          FSL       8-15%      S13          119
2.  35      TUNBRIDGE                      FSL       3-15%      S12          245
3.  10      RICKER                         PEAT      8-15%      H01         B 77
4.   5      ABRAM                          FSL       8-15%      E05         D 43
5.   5      ROCK OUTCROP                                        M01          349
6.   5      SKERRY                         FSL       3-8%       S14          223
7.   5      BERKSHIRE                      FSL       8-15%      S11           27
=========================================================================
  PARENT MATERIAL                         PARENT MATERIAL
  MODE OF DEPOSITION                      ORIGIN

1. GLACIAL TILL                           MXD-IGNS & MTAMORPHC
2. GLACIAL TILL                           MXD-IGNS & MTAMORPHC
3. ORGANIC                                ORGANIC
4. GLACIAL TILL                           MXD-IGNS & MTAMORPHC
5.
6. GLACIAL TILL                           MXD-IGNS & MTAMORPHC
7. GLACIAL TILL                           MXD-IGNS & MTAMORPHC
=========================================================================
 DEPTH TO BEDROCK (CM)                DEPTH TO IMPERMEABLE LAYER (CM)

1.              25                                 43
2.              50                                 71
3.              10                                 23
4.              10                                 13
5.               0                                  0
6.             150                                 64
7.             150                                150
=========================================================================
  PERMEABILITY                     DRAINAGE                  HYDROLOGIC GROUP

1.                                 SOMEWHAT EXCESSIVE               D
2.                                 WELL                             B
3.                                 SOMEWHAT EXCESSIVE               C
4.                                 EXCESSIVE                        D
5.                                                                  D
6.                                 MODERATELY WELL                  C
7.                                 WELL                             B
=========================================================================
  SUBGROUP                            PARTICLE SIZE             MINERALOGY

1. LITHIC  HAPLORTHODS                LOAMY                     MIXED
2. TYPIC  HAPLORTHODS                 COARSE-LOAMY              MIXED
3. LITHIC  BOROFOLISTS
4. LITHIC  UDORTHENTS                 LOAMY                     MIXED
5.
6. AQUIC  HAPLORTHODS                 COARSE-LOAMY              MIXED
7. TYPIC  HAPLORTHODS                 COARSE-LOAMY              MIXED
=========================================================================
  REACTION                         TEMPERATURE REGIME               OTHER

1.                                    FRIGID
2.                                    FRIGID
3.                                    FRIGID
4.                                    FRIGID
5.
6.                                    FRIGID
7.                                    FRIGID
=========================================================================
```

Figure 2-1 Soil Map Unit Worksheet (example)

form (Figure 2-2) or soil transect data form (Figure 2-3). Taxonomic unit descriptions made during transecting may be recorded on the soil transect data form if there is enough space to legibly record important characteristics. The official soil series description will be used as the reference or representative soil description for series taxonomic units. Taxonomic units other than series will be represented by one of the two field soil descriptions.

IDENTIFICATION LEGEND

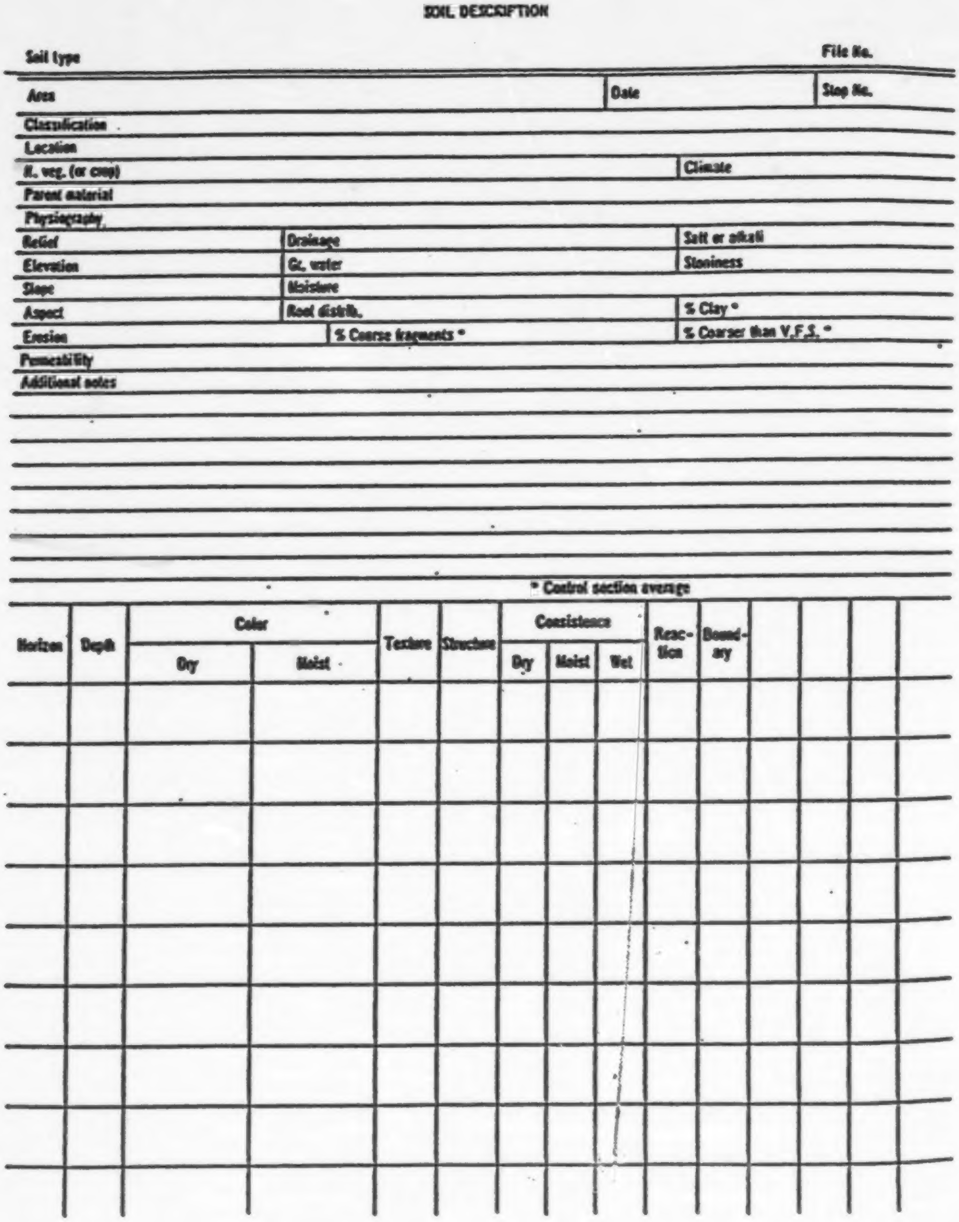
The identification legend consists of the name of the soil survey area and the date that the legend was prepared, a list of symbols to identify soil map units and names of soil map units. The identification legend is entered into a data management file at the USEPA's Environmental Research Laboratory, Corvallis, Oregon (ERL-C). Changes or additions to the legend are submitted through the Soil Conservation Service (SCS) State Soil Scientist and Regional Coordinator/Correlator (RCC) to the Mapping Task Leader at ERL-C.

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

A conventional and special symbols legend consists of a list of conventional symbols used to identify manmade works and structures, boundaries and drainage; and a list of special symbols to identify areas of soil, special features or kinds of miscellaneous areas that are too small to be delineated at the scale of mapping. The Conventional and Special Symbols Legend Form (SCS-SOI-37A) will be used to prepare the conventional and special symbols legend.

SOIL MAP UNITS

Soil map units are designed and delineated to relate soil patterns to naturally occurring landscape elements or segments. Soil mapping is based on enough observations to determine soil/landscape relationships and to confirm predictions of soil occurrence established from these relationships. The scientific basis for mapping is that soils and their location on the landscape are predictable to an experienced soil scientist with a knowledge of the geology, vegetation, climate, and landform patterns of the area.



SOIL DESCRIPTION

Soil type
File No.

Area
Date
Stop No.

Classification

Location

N. veg. (or crop)
Climate

Parent material

Physiography

Relief
Drainage
Salt or alkali

Elevation
Gr. water
Stoniness

Slope
Moisture

Aspect
Root distrib.
% Clay *

Erosion
% Coarse fragments *
% Coarser than V.F.S. *

Permeability

Additional notes

* Control section average

Horizon	Depth	Color		Texture	Structure	Consistence			Reac-tion	Bound-ary				
		Dry	Moist			Dry	Moist	Wet						

Figure 2-2 Soil Description Form

________ Co. Soil Transect Sheet

FILE NO: ________ MAP UNIT: ________ DATE: ________ BY: ________

LOCATION: ________ DIRECTION: ________

INTERVAL: ________ LENGTH: ________ PHOTO: ________ QUAD SHEET: ________ ELEV.: ________

REMARKS: ________

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH
NOTES:						
				SERIES:		

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH
NOTES:						
				SERIES:		

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH
NOTES:						
				SERIES:		

PEDON	ASPECT		SLOPE	POSITION		
HORIZON	DEPTH	COLOR	TEXTURE	MOTTLES	FRAG.	pH
NOTES:						
				SERIES:		

Figure 2-3 Soil Transect Data Sheet

Map units for the survey are mostly consociations and complexes with occasional undifferentiated groups. Map units are named for the major component(s) of the unit. Components of map units are mostly phases of soil series or miscellaneous areas; map unit components named at a categorical level above series may also be used. The range in characteristics of one soil component should not be so great to include strongly contrasting soils.

Characteristics of each map unit will be described and recorded in tabular format on the Soil Map Unit Worksheet (Figure 2-1). The following information will be recorded:

- map symbol,
- name of map unit,
- dominant landform: regional, local,
- geomorphic position in landscape,
- slope configuration: across, down,
- soil components: extent (%), name, and
- additional notes.

The extent of major map unit components and inclusions (soils or miscellaneous areas) will be estimated from landscape relationships, aerial photograph interpretation and field observations. Transect observations will help to determine the composition of a map unit, but will not always provide the most accurate estimate.

3 END PRODUCTS OF MAPPING

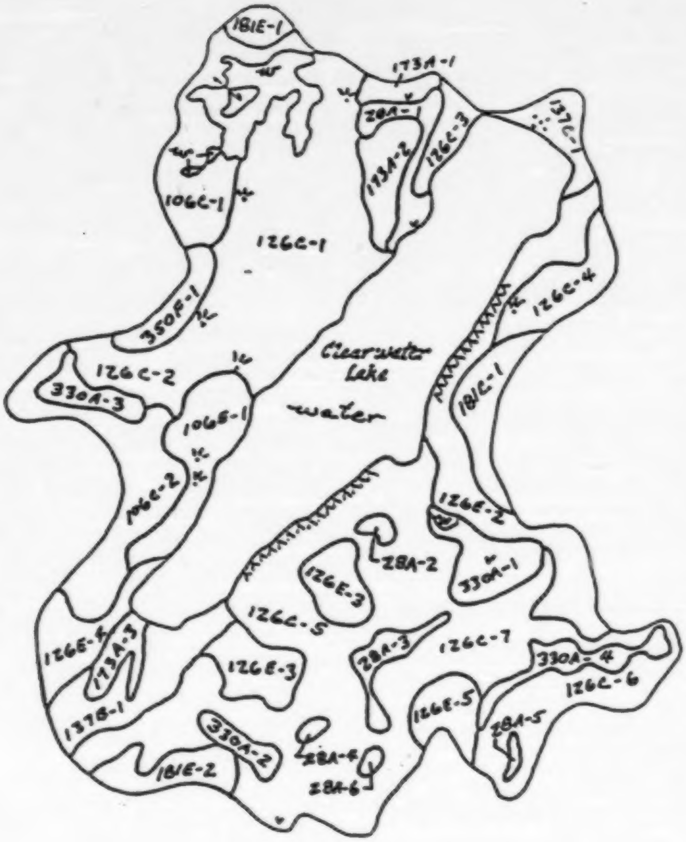
Landscape attributes will be inventoried in watersheds selected for the project. Watershed boundaries will be interpreted from topographic quadrangle maps and with stereoscopic study of aerial photographs to verify that the boundary delineates the area that drains to the downstream sample point or lake. Segments of the watershed boundary that are uncertain will be field checked.

Products delivered from watershed mapping activities include:

- Soil maps at 1:24,000 scale on mylar overlays of US Geological Survey (USGS) topographic quadrangles with contrasting kinds of soils to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Soil transect maps on mylar overlay at 1:24,000 scale.
- Estimated depth to bedrock maps on mylar overlays at 1:24,000 scale using six specified depth classes to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Landuse/forest cover maps on mylar overlays at 1:24,000 scale to a minimum delineation of 2 to 6 acres (2 acres on hydric or soils formed in alluvium).
- Maps of watershed drainage system and other water features on a mylar overlay of a topographic quadrangle map at 1:24,000 scale.
- Identification legend, conventional and special symbols legend.
- Descriptions of the map units recorded in tabular format on map unit worksheets; supported by a minimum of one field note for each map unit on each watershed.
- Descriptions of the soils; a minimum of two soil pedon descriptions (field note) for each kind of soil (series) mapped and a copy of the Official Soil Series Description with the range in characteristics adjusted to reflect the soil as mapped in the region.
- Transect data, one randomly selected, 10-point transect of each different map unit on a watershed (all map units if 10 or less plus 1/2 of the number of different map units greater than 10).

SOIL MAPS

Soil maps are drafted on mylar overlays (Figure 3-1) registered to a 1:24,000 scale topographic quadrangle or orthophotoquad base map. Minimum size delineation of soil map units is 2 to 6 acres.



SOILS OVERLAY

CLEARWATER LAKE
1K029043

LEGEND

MAP UNIT SYMBOL	MAP UNIT NAME	ACRES	AVAILABLE TRANSECTS
* 28A	BIDDEFORD MUCKY PEAT, 0-3% SLOPES	41.4	1,2,③,4,5,6
* 106C	LYMAN-ROCK OUTCROP-TUNBRIDGE COMPLEX, 3-15% SLOPES	82.9	1,②
106E	LYMAN-ROCK OUTCROP-TUNBRIDGE COMPLEX, 15-45% SLOPES	28.7	1,
* 126C	MONSON-ROCK OUTCROP-ELLIOTTSVILLE COMPLEX, 3-15% SLOPES	350.7	①2,3,4,5,6,7
* 126E	MONSON-ROCK OUTCROP-ELLIOTTSVILLE COMPLEX, 15-45% SLOPES	89.2	1,②,3,4,5
* 137B	NICHOLVILLE SILT LOAM, 3-8% SLOPES	28.7	①
* 137C	NICHOLVILLE SILT LOAM, 8-15% SLOPES	22.3	①
* 173A	ROUNDABOUT SILT LOAM, 0-3% SLOPES	28.7	1,②,3
* 181C	ABRAM-ROCK OUTCROP COMPLEX, 3-15% SLOPES	19.1	①
* 181E	ABRAM-ROCK OUTCROP COMPLEX, 15-45% SLOPES	22.3	1,②
* 330A	BUCKSPORT MUCK, 0-3% SLOPES	51.0	①2,3,4
* 350F	ROCK OUTCROP	12.7	①
W	WATER	237.1	
	TOTAL	1014.8	

Figure 3-1 Soil Map (example)

Inclusions may be greater than 6 acres if the differences are slight and if there is no readily observable landscape feature to use for delineation. Only hydric soils and soils formed in alluvium should be delineated at less than 6 acres.

The soils in each delineation are identified by transecting, traversing, and field investigation of each delineation. Soil map unit boundaries are drawn from observation and interpretation of aerial photographs, follow landscape features, and are verified by field observations. More specifically:

- The most current readily available aerial photographs are used.
- Map units conform to topographic and landscape features and photo imagery.
- All map delineations are traversed or visited in the field. If soils in the watershed have previously been mapped the information may be used, but the watershed should be visited and remapped at 1:24,000 scale using the soil survey legend developed for the DDRP.
- Acres of each map unit are measured and tallied by watershed.
- Field notes are systematically recorded for all watersheds.
- Use Special Symbols for Soil Survey as shown in the Conventional and Special Symbols Legend, SCS-SOI-37A.
- Anything unusual about the watershed, including any access or potential sampling problems, is documented in the field notes.
- Any subjective decisions (i.e., decisions not based on pre-existing criteria), including logic and rationale are documented in the additional notes section of the field notes.
- The map unit symbol, name of the map unit and total acres of each map unit are recorded in a soil legend on the soil map of each watershed.
- An available transect is identified for each delineation on the soil map by numbering consecutively for each kind of map unit. The number is followed by a dash after the map symbol (eg. 126C-1, 126C-2, 126C-3). Available transects will be listed with the soil legend for each watershed, and selected transect numbers will be circled.

SOIL TRANSECT OVERLAY

Actual soil transects, which are randomly selected for field documentation, are marked on a soil transect overlay (Figure 3-2) at a map scale of 1:24,000. The transect location will be indicated with a line and an arrow shows the direction in which the transect was run.

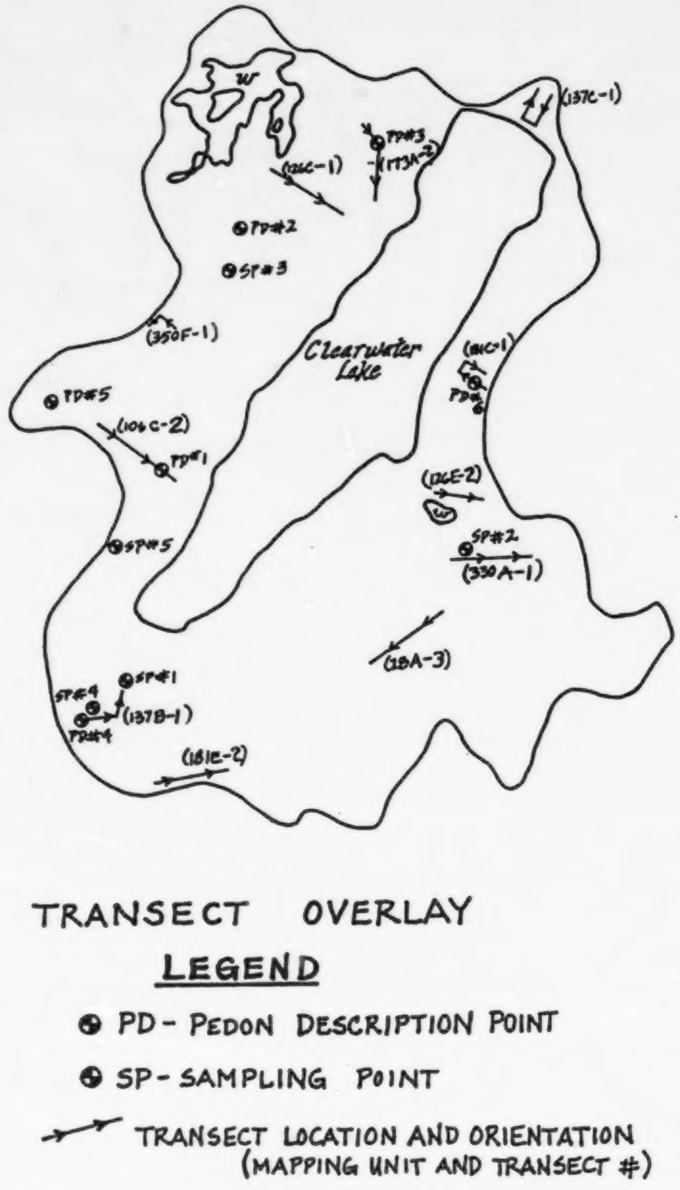


Figure 3-2 Transect Overlay (example)

As part of field mapping, soil scientists determine available transects that represent map unit delineations.

- At least one available transect is identified for each map unit delineation. Additional available transects are identified in large delineations at a ratio of about 1 transect per 160 acres. Available transects for each kind of map unit are numbered sequentially beginning with the number 1. For example, the 3rd delineation of map unit 126C is identified by the transect code 126C-3. Available transects are listed by numbering sequentially to the right of the name of the map unit in the soil legend on the soil overlay. (eg. 126C...Alpha sandy loam 2 - 8 % slopes....1,2,3,4; shows there are 4 available transects of map unit 126C.)

- Transects usually are oriented at right angles to drainage patterns and cross most of the delineation, include most of the range in elevation, and represent the typical landscape of the area delineated.

- Soil Scientists conduct a minimum of one transect of each different map unit in a watershed with ten or fewer map units. Watersheds with more than 10 map units will have the minimum ten transects plus half of the number of map units greater than 10 (e.g., a watershed with 18 map units would have 10 plus half of 8 or a total of 14 map units transected). In this example, 14 map units to transect would be randomly selected from the 18 map units on the watershed. A map unit selected is indicated with an asterisk (*) to the left of the map symbols in the legend. A transect for each map unit is randomly selected from the list of available transects for the map unit.

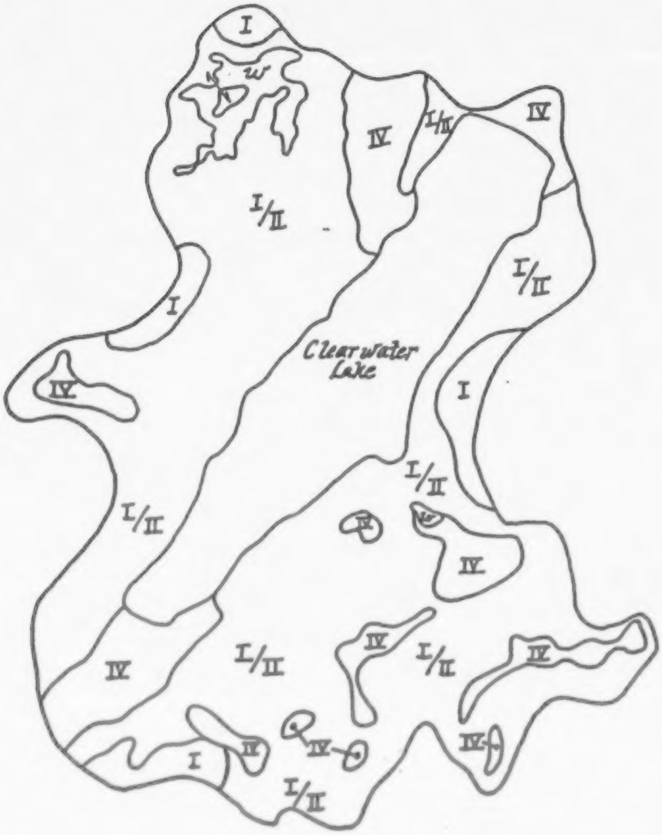
- Each selected transect is indicated by circling the corresponding number in the legend and located on the transect overlay of the watershed. Transects are labeled with the map unit symbol and number of the available transect that was selected (Figure 3-1).

- Data points along random transects are determined by the point intercept method at 10 equally spaced observations along each transect. Shape of transects (e.g., straight-line, dog-leg or zig-zag) are determined by the shape and size of the delineation. Distance between observations varies depending on the length of the transect (minimum distance = 10 meters).

- Transect data are recorded on the Soil Transect Data Sheet (Figure 2-3). A transect code consisting of the watershed code, map unit symbol and available transect number (eg. 2Z01234-126C-3) are recorded on the transect data sheet. Soil characteristics recorded on the transect data sheet are used to document the kind of soil that occurs at the observation point and whether the soil is similar or dissimilar to soil components described for the map unit. Soils similar to, but with properties outside, the official description are identified as taxadjuncts and noted as to how the soil is different. Transect data will support description of the range in characteristics of soil series mapped.

DEPTH-TO-BEDROCK MAPS

Depth to bedrock maps are made during the course of soil mapping. The maps are drafted on mylar overlays (Figure 3-3) registered to a topographic quadrangle map or orthophotoquad base



DEPTH TO BEDROCK OVERLAY

LEGEND

CLASS	DEPTH
I	LESS THAN 0.5 m.
II	0.5 - 1.0 m.
III	1.0 - 2.0 m.
IV	2.0 - 5.0 m.
V	5.0 - 30.0 m.
VI	> 30 m.

Figure 3-3 Depth to Bedrock Map (example)

map at a scale of 1:24,000. Each delineation on the soil map is assigned at least one, but no more than three of the six depth classes. A class is assigned for each major (named) soil of the map unit with a different depth class. The depth to bedrock map symbol for a delineation lists the depth to bedrock classes in decreasing order of estimated extent. From this survey, a depth to bedrock map on a mylar overlay is made by combining contiguous soil map delineations with the same depth to bedrock class. A soil map delineation may be segmented into more than one depth to bedrock class where necessary. Depth to bedrock is estimated from all available information including soils data, road cuts, and stream incisements. The depth-to-bedrock classes are listed in Table 3-1.

FOREST COVER MAPS

Landuse and forest cover type will be mapped on a mylar overlay of a 1:24,000 scale topographic quadrangle or orthophotoquad base map (Figure 3-4). Landuse is designated by one of the codes from Table 3-2.

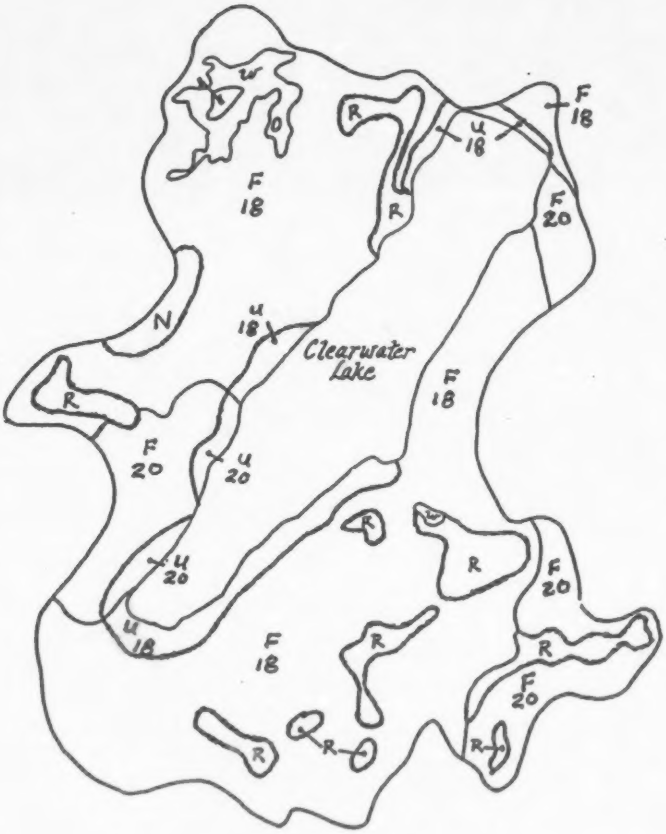
Landuse is easily confused with land type. Wetlands, barren land and tundra do not connotate a landuse per se, however, they do label segments of the land surface on which the use is limited because of their unique characteristics. The landuse of a forest clear-cut is forest and the forest cover type should be designated where possible. Forest cover is designated on a map overlay with the appropriate numeric code from the Society of American Foresters (SAF), (Eyre, F.H., 1980). Those delineations with forest cover are labeled with the landuse letter code above the forest cover type numeric code (e.g., F/52).

Delineations are made from aerial photograph imagery, and topographic and landscape features. Delineations are confirmed by field observation during the course of soil mapping. The area of each landuse and covertype is measured and tallied from the GIS after being digitized.

Cultural features including roads, mines. cabins or farmsteads, mine dumps, waste disposal areas and industrial sites too small to delineate are shown with conventional or special symbols on the Landuse/Forest Cover map.

Table 3-1 Depth-to-Bedrock Classes

Class	Depth, meters	Confidence Level
I	< 0.5	High
II	0.5 - 1	High
III	1 - 2	High
IV	2 - 5	Moderate
V	5 - 30	Low
VI	> 30	Low



LAND USE AND FOREST COVER TYPES OVERLAY

LAND USE TYPES

SYMBOL	LAND USE
F	FOREST LAND NOT GRAZED
N	BARREN LAND
R	WETLANDS
U	URBAN AND BUILT-UP LAND

COVER TYPES

SYMBOL	TYPE
18	WHITE BIRCH
20	WHITE PINE, RED OAK, RED MAPLE

Figure 3-4 Landuse and Forest Cover Map (example)

Table 3-2 Landuse Codes

Landuse	Codes
Cropland	C
Forest land, grazed	E
Forest land. not grazed	F
Pasture land & native pasture	G
Horticultural land	H
Cropland, irrigated	I
Waste disposal land	L
Barren land	N
Rangeland, grazed	P
Rangeland, not grazed	S
Wetlands	R
Wetlands, drained	Q
Tundra	T
Urban & built-up land	U

DRAINAGE AND WATER FEATURE MAPS

Watershed drainages are shown on mylar overlays of topographic quadrangle base maps at a scale of 1:24,000. Standard map symbols are used to show all perennial streams, dominant (well-defined) intermittent stream channels, surface water bodies, and other water features on the overlay (Figure 3-5). The marsh or swamp symbol is used to show areas of less than two acres with standing water; larger marsh or swamp areas are delineated on the drainage overlay and labeled with an "S". The wet spot symbol is used to designate areas of less than 2 acres that are somewhat poorly drained or wetter and are two drainage classes wetter than the mapped soil. The upper end of perennial streams is shown with a short red line across the stream symbol. Incorrect drainages and drainage changes since publication of the topographic map need to be corrected or added.

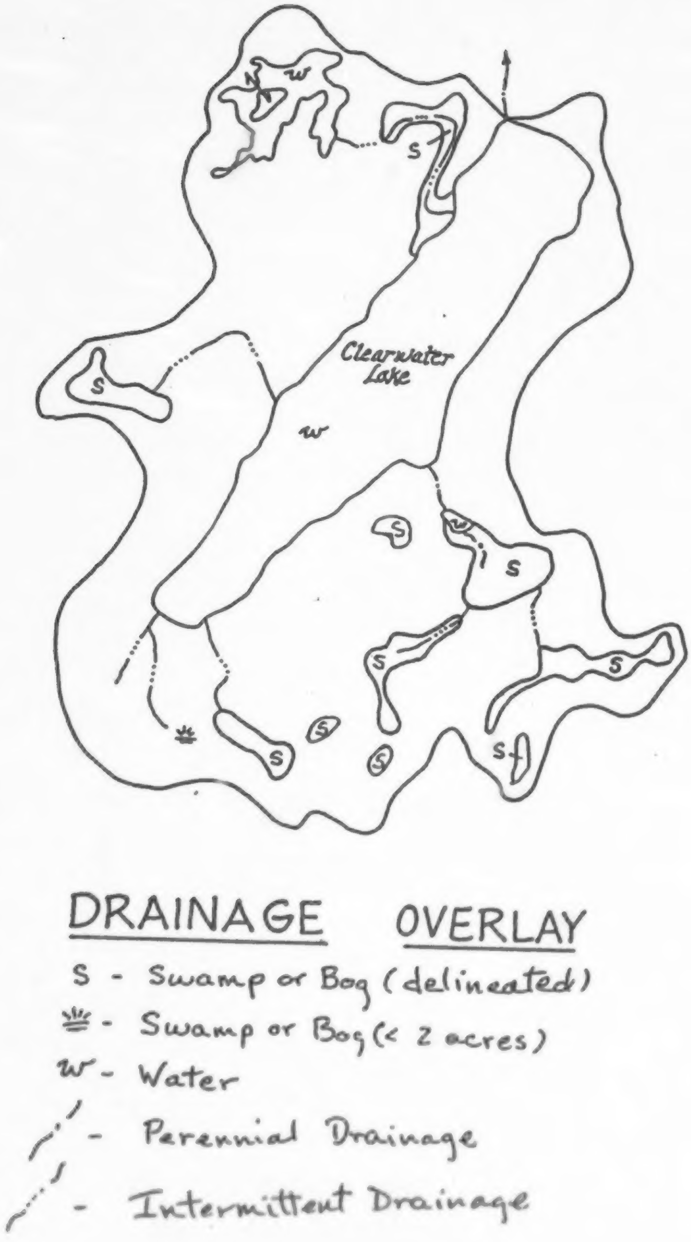


Figure 3-5 Drainage Map (example)

4 MAPPING QUALITY ASSURANCE AND QUALITY CONTROL

APPROACH

Soil map quality can be judged by ground truth. Ground truth is the degree to which the map unit description accurately represents the "soilscape." Ground truth depends on: (1) accuracy and location of soil boundaries; (2) the correctness of information at each point investigated within the map unit delineation (Is it or is it not within the soils as described in the map unit?); (3) the overall correctness of the map unit description, including the total extent of inclusions. Boundary errors can be combined with correctness of information errors since, if the boundary is not located correctly, the correctness of information or classification of the land is in the "wrong" delineation and will be counted as an error. Evaluation of map quality has both quantitative and qualitative components.

Quantitative Component

A quantitative measure of the accuracy of a soil map is the proportion of the map area in which the reported soils information (the map unit description) is correct. In particular, each point on a soil map is included in a delineation. In turn, each map delineation represents a map unit which is described in the descriptive legend. An integral part of the description of each map unit is the relative proportion (%) of dissimilar soil components. This can be tested (by survey parties and/or independent observers) by examining point locations along transects within the map unit delineation in the field and comparing the frequency with which soils are observed to the percentages in the map unit description. For purposes of this soil survey, it is assumed that the scale, legend, and base map are adequate and the accuracy of the soil map (mapping) is to be evaluated.

A modification of the random transect method (Steers and Hajek, 1979) is used to quantitatively evaluate the correctness of the soil map units. This method is a procedure for random sampling of map units and a statistical method for analyzing field data.

Qualitative Component

The qualitative component of mapping quality requires independent review of the performance of the survey parties. Items that can be evaluated include adherence to protocols, identification of soils, placement of boundaries, note taking, and general accuracy and care with which delineations and watershed characteristics are recorded.

TASKS FOR SURVEY PARTIES

The soil survey party leader and soil mappers perform the first level of quality control. They must make decisions in the field that result in correct identification and description of soils, proper delineation and description of map units and diligent note taking. Their tasks are to produce the mapping products consistent with mapping protocols and standards recognized by the National Cooperative Soil Survey.

TASKS FOR (SCS) STATE SOILS STAFFS

A soil scientist from the soils staff of the SCS state office assigned responsibility for the survey party conducts field reviews. Each party participating in the soil survey is reviewed during the course of mapping. The review includes at least one watershed mapped by each soil survey party and is done in accordance with procedures specified in the National Soils Handbook Chapter 10, Progress Field Reviews (Soil Survey Staff, 1983). A written review report is submitted on the Field Review Report Form (Figure 4-1) to ERL-C and the RCC before the completion of mapping. Any deviations from the mapping protocol, and proposed corrective action, are reported to ERL-C and the RCC immediately. Emphasis is on the accuracy of the mapping, its consistency, and conformance with USEPA specified protocols for this survey. More specifically, the mapping is examined for soil identification, placement of boundaries, legibility, inclusions, conformance with descriptive legend and how well the map unit fits the proposed use of survey data. The adequacy of the field notes, and the general accuracy and care with which watershed characteristics were recorded, and are evaluated. About 25 percent of the soil map units in the watershed are traversed or transected by the soil scientist conducting the review. Data are recorded on the Map Adequacy Check Form (Figure 4-2) or Soil Transect Data Sheet (Figure 2-3) and evaluated. Corrective action recommended during the field review will be checked by the State Soils Staff after the required corrections have been made and initialed on the field review report form by the reviewer.

TASKS FOR REGIONAL COORDINATOR/CORRELATOR (RCC)

The RCC participates in at least one progress field review for SCS personnel in each state. About 20 percent of the mapped watersheds is selected by USEPA for independent evaluation by the RCC. About 20 percent of the map delineations in each of the watersheds is selected for transecting by the RCC. Transecting by the RCC is conducted in the same manner as specified for routine transects. The RCC also evaluates mapping on the selected watersheds by aerial photograph interpretation and traversing of 20 to 50 percent of the map units.

Page 1 of 6

MAPPING FIELD REVIEW REPORT FORM
FOR THE
DIRECT/DELAYED RESPONSE PROJECT

(Format and appropriate content from SCS Field Review Report Form SCS-SOI-233)

1. GENERAL

1.1 Watershed Data

1.1.1 Watershed Number ____________________

1.1.2 Watershed Name ____________________

1.1.3 County and State ____________________

I.1.4 Watershed Area ____________________ acres

I.I.5 Mapped Area ____________________ acres

I.2 Administrative Data

1.2.1 Date of Review ____________________

I.2.2 Person(s) conducting review ____________________

1.2.3 Mapping Team Leader ____________________

I.2.4 Other Team Members ____________________

____

1.2.5 Other Review Participants ____________________

____

2. REVIEW OF MAPS AND DOCUMENTATION

2.1 Maps

2.1.1 Are recent aerial photographs being used? ____________________

2.1.2 Base Map ____________________ Scale ____________________

2.1.3 Are overlays registered to base map? ____________________

2.1.4 Has one overlay been used where quad sheets join? ____________________

Figure 4-1 Field Review Report Form

Page 2 of 6

2.1.5 Have overlays been prepared? Soils________Soil Transect____________

Landuse/Forest Cover____________Depth to Bedrock________________

Geology______________________Drainage________________________

2.1.6 Are map symbols in all delineations?________________________

2.I.7 Are symbols legible and oriented?__________________________

2.1.8 Have hydric and alluvial areas been mapped at greater intensity?

____

2.1.9 Have conventional and special symbols been used where appropriate?

____

2.1.10 Soils
(a) Are soil map symbols in the regional legend?__________________

(b) What new map units are proposed in this watershed?____________

____

(c) Have new map unit symbols and Soil Map Unit Worksheet(s) been

submitted to RCC?____________________________Date__________

2.1.11 Landuse/Forest Cover

(a) Are the specified landuse and cover type symbols used?__________

(b) Do all delineations have a landuse symbol?____________________

(c) Do all forested areas have cover type symbols?________________

2.1.12 Depth to Bedrock
(a) Do depth to bedrock map delineations correspond to soil map

delineations?__________________If not explain______________

____

(b) Do depth to bedrock classes correspond to soil depths:__________

(c) If complex (multiple) depth to bedrock classes were used , are

the classes listed in decreasing order of extent?______________

Figure 4-1 Field Review Report Form (continued)

Page 3 of 6

2.1.13 Geology

(a) Does the state map adequately portray the bedrock geology of the watershed? If not, have changes been indicated on a mylar overlay?____________________

(b) Are geology map symbols the same as on the reference map? (check upper case vs lower case letters)____________________

(c) Has the reference for corrections to the geology overlay been given?____________________

(d) Are descriptions of geologic units, not on the state geology base map, correlated with the state geology map?____________________

2.1.14 Drainage

(a) Are perennial and intermittent streams shown on a drainage overlay using standard symbols?____________________

(b) Is the difference between a perennial stream and intermittent stream cartographically precise?____________________

(c) Are lakes, reservoirs and other surface water bodies correctly located on the drainage overlay?____________________

(d) Are there any diversions of surface water into or out of the watershed?____________________

(e) Is the watershed boundary correctly located on the watershed divide?____________________

(f) Was the watershed boundary checked in the field to verify interpretation from topographic contour lines or aerial photography?____________________

(g) Do drainages conform to topographic map crenulations?__________

Figure 4-1 Field Review Report Form (continued)

2.1.15 Are map symbols, map unit names, and area of each map unit in acres (soils overlay only),in a map legend on the map sheet:

Soils?____

Landuse?______________________________________

Forest Cover Type?______________________________
Depth to Bedrock Class?___________________________

Bedrock Geology?________________________________

2.2 Documentation

2.2.1 Soil Taxonomic Units

(a) Which soil components of map units have been described on this watershed?____________________________________

____

____

(b) Are the soil descriptions adequate and correct?______________

(c) Are additional descriptions needed?________________________

2.2.2 Soil Map Units

(a) Is there a Soil Map Unit Worksheet or map unit notes for each map unit in the watershed?________________________________

(b) Are differences in map unit composition for this watershed indicated on the map unit worksheet?_______________________

(c) Is the information on the map unit worksheet complete and correct?____

2.2.3 Soil Transects

(a) Is there a soil transect for each map unit in the watershed as prescribed in the protocol?_______________________________

Figure 4-1 Field Review Report Form (continued)

(b) Are map units to transect being randomly selected where there are more than 10 map units per watershed?________________

(c) Are transects being randomly selected from a list of available transects for each map unit?________________

(d) Are available transects located on the transect overlay and transect direction indicated?________________

(e) Are the Soil Transect Data Sheets complete and correct?________

(f) Do transect data verify the map unit is correct?____________

3. MAPPING EVALUATION

3.1 Do map unit boundaries conform to the natural landscape?____________

3.2 Do soils mapped reflect differences in parent material origin and mode of deposition?________________

3.3 Is the soil map line intensity about right for the scale of mapping and topographic features?________________

3.4 Does a random traverse of the watershed indicate the mapping is correct?________________

3.5 Are soils mapped and correlated to distinguish important soil characteristics that influence waterflow and soil water chemistry in the watershed?

(a) Soil depth________________

(b) Parent Material________________

(c) Soil Drainage________________

(d) Soil Permeability________________

(e) Particle-size Class________________

(f) Organic Matter________________

(g) Diagnostic Horizons________________

Figure 4-1 Field Review Report Form (continued)

4. RESULTS AND SIGNATURE

4.1 Deficiencies noted during review:____________________

____

____

____

4.2 Corrective action required:____________________

____

____

____

____

4.2.1 Corrective Action Completed

(a) Date corrective action completed____________________

(b) Mapper: Initials____________ Date____________

(c) Reviewer: Initials____________ Date____________

4.3 Is mapping acceptable (soil, landuse/forest cover, drainage, depth to bedrock, geology)?____________ Explain if not acceptable:

____

____

4.4 Comments:____________________________________

____

____

____

4.5 Signature of Reviewer____________________ Date____________

Figure 4-1 Field Review Report Form (continued)

MAP ADEQUACY CHECK FORM
USEPA-SCS
DIRECT/DELAYED RESPONSE PROJECT

Watershed No:_____________
Mapped by:_______________
Evaluated by:_____________
Size Area Evaluated:
(1/2 sq. mi. or other______)

Date:____________________
Traverse No:_______________
Evaluation Results
(Acceptable Unacceptable)

(0 - No deviation) (1 - One deviation from Expected) (2 - Two deviations from Expected)

Stop No	Map Unit Symbol	Depth to Rock or Slowly Perm	Drainage Class	Family Texture	Parent Material Mode/Origin	Comments

Figure 4-2 Map Adequacy Check Form

5 REFERENCES

Eyre, F. H. 1980. Forest Cover Types of the United States and Canada. Society of American Foresters, Washington, D.C.

Soil Survey Staff. 1983. National Soils Handbook. US Government Printing Office, Washington, D.C.

Soil Survey Staff. 1975. Soil Taxonomy. USDA Soil Conservation Service. Agricultural Handbook No. 436. US Government Printing Office, Washington, D.C.

Steers, C. A. and B. F. Hajek. 1979. Determination of map unit composition by a random selection of transects. Soi. Sci. Soc. Amer. Jour. 43:156-160.

APPENDIX B:

DIRECT/DELAYED RESPONSE PROJECT:
SOIL LEGEND FOR MAPPING
IN THE MID-APPALACHIAN REGION OF THE UNITED STATES

DIRECT/DELAYED RESPONSE PROJECT: MID-APPALACHIAN REGION SOIL LEGEND

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
0W		251	WATER
4A		171	ANDOVER CHANNERY LOAM, 00-03% SLOPES
4B		7	ANDOVER CHANNERY LOAM, 03-08% SLOPES
5B		34	ARMAGH SILT LOAM, 03-08% SLOPES
6B		56	ARNOT-OQUAGA CHANNERY LOAMS, 03-08% SLOPES
6D		9	ARNOT-OQUAGA CHANNERY LOAMS, 15-25% SLOPES
7A		143	ATKINS SILT LOAM, 00-03% SLOPES
9A		42	BASHER GRAVELLY LOAM, 00-03% SLOPES
10B		526	BATH CHANNERY SILT LOAM, 03-08% SLOPES
10C		512	BATH CHANNERY SILT LOAM, 08-15% SLOPES
10D		424	BATH CHANNERY SILT LOAM, 15-25% SLOPES
11B		195	BEDINGTON CHANNERY SILT LOAM, 03-08% SLOPES
11C		19	BEDINGTON CHANNERY SILT LOAM, 08-15% SLOPES
13B		204	BERKS CHANNERY SILT LOAM, 03-08% SLOPES
13C		683	BERKS CHANNERY SILT LOAM, 08-15% SLOPES
13D		152	BERKS CHANNERY SILT LOAM, 15-25% SLOPES
13F		587	BERKS CHANNERY SILT LOAM, 35-70% SLOPES
14B		90	BERKS-WEIKERT CHANNERY SILT LOAMS, 03-08% SLOPES
14C		749	BERKS-WEIKERT CHANNERY SILT LOAMS, 08-15% SLOPES
14D		802	BERKS-WEIKERT CHANNERY SILT LOAMS, 15-25% SLOPES
14E		595	BERKS-WEIKERT CHANNERY SILT LOAMS, 25-35% SLOPES
14F		4714	BERKS-WEIKERT CHANNERY SILT LOAMS, 35-70% SLOPES
15C		24	BLAIRTON CHANNERY SILT LOAM, 08-15% SLOPES
17A		346	BRINKERTON SILT LOAM, 00-03% SLOPES
17B		257	BRINKERTON SILT LOAM, 03-08% SLOPES
18B	66B	1689	BUCHANAN CHANNERY SILT LOAM, 03-08% SLOPES
18C	2B, 133C	798	BUCHANAN CHANNERY SILT LOAM, 08-15% SLOPES
18D		17	BUCHANAN CHANNERY SILT LOAM, 15-25% SLOPES
19B		349	CALVIN CHANNERY SILT LOAM, 03-08% SLOPES
19C		309	CALVIN CHANNERY SILT LOAM, 08-15% SLOPES
19D		337	CALVIN CHANNERY SILT LOAM, 15-25% SLOPES
19E		395	CALVIN CHANNERY SILT LOAM, 25-35% SLOPES
19F		86	CALVIN CHANNERY SILT LOAM, 35-65% SLOPES
20F		623	CALVIN-DEKALB-HAZLETON COMPLEX, 35-65% SLOPES
22A		54	CARLISLE MUCK, 00-03% SLOPES
23F	23E	68	CATEACHE CHANNERY SILT LOAM, 35-65% SLOPES
24C		180	CATASKA CHANNERY SILT LOAM, 08-15% SLOPES
24D		161	CATASKA CHANNERY SILT LOAM, 15-25% SLOPES
24F		1106	CATASKA CHANNERY SILT LOAM, 35-60% SLOPES
25B		197	CAVODE-ERNEST-WHARTON SILT LOAMS, 03-08% SLOPES
27A		37	CODORUS LOAM, 00-03% SLOPES
28A		72	CHIPPEWA CHANNERY SILT LOAM, 00-03% SLOPES
28B		247	CHIPPEWA CHANNERY SILT LOAM, 03-08% SLOPES
29B		950	CLYMER CHANNERY LOAM, 03-08% SLOPES
29C		79	CLYMER CHANNERY LOAM, 08-15% SLOPES
30B		1257	COOKPORT CHANNERY LOAM, 03-08% SLOPES
31A	76A, 102A, 136C	568	CRAIGSVILLE VERY GRAVELLY SANDY LOAM, 00-05% SLOPES
32B	32C	15	DEKALB CHANNERY LOAM, 03-08% SLOPES

DDRP: MID-APPALACHIAN REGION SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
32D		42	DEKALB CHANNERY LOAM, 15-25% SLOPES
32E		22	DEKALB CHANNERY LOAM, 25-35% SLOPES
33B		65	DEKALB CHANNERY LOAM, 03-08% SLOPES, STONY
36B		1708	ERNEST SILT LOAM, 03-08% SLOPES
36C	134B	716	ERNEST SILT LOAM, 08-15% SLOPES
36D		80	ERNEST SILT LOAM, 15-25% SLOPES
37B		21	EUBANKS LOAM, 03-08% SLOPES
37C		56	EUBANKS LOAM, 08-15% SLOPES
37D		40	EUBANKS LOAM, 15-25% SLOPES
37E		58	EUBANKS LOAM, 25-35% SLOPES
38B	(30B)	39	FENWICK SILT LOAM, 03-08% SLOPES
40C		25	GAULEY CHANNERY SANDY LOAM, 08-15% SLOPES, STONY
41B		120	GILPIN CHANNERY SILT LOAM, 03-08% SLOPES
41C		402	GILPIN CHANNERY SILT LOAM, 08-15% SLOPES
41D		1067	GILPIN CHANNERY SILT LOAM, 15-25% SLOPES
41E		406	GILPIN CHANNERY SILT LOAM, 25-35% SLOPES
41F		4376	GILPIN CHANNERY SILT LOAM, 35-70% SLOPES
42C	42B	24	GILPIN-LILY COMPLEX, 08-15% SLOPES
44B		373	HARTLETON CHANNERY LOAM, 03-08% SLOPES
44D		40	HARTLETON CHANNERY LOAM, 15-25% SLOPES
45B		685	HAZLETON CHANNERY LOAM, 03-08% SLOPES
45C		400	HAZLETON CHANNERY LOAM, 08-15% SLOPES
45D		147	HAZLETON CHANNERY LOAM, 15-25% SLOPES
45E		67	HAZLETON CHANNERY LOAM, 25-35% SLOPES
45F		487	HAZLETON CHANNERY LOAM, 35-65% SLOPES
46B		4128	HAZLETON CHANNERY LOAM, 03-08% SLOPES, STONY
46C		2095	HAZLETON CHANNERY LOAM, 08-15% SLOPES, STONY
46D		2285	HAZLETON CHANNERY LOAM, 15-25% SLOPES, STONY
46E	33E	2616	HAZLETON CHANNERY LOAM, 25-35% SLOPES, STONY
46F		2092	HAZLETON CHANNERY LOAM, 35-65% SLOPES, STONY
47B		421	HAZLETON-DEKALB CHANNERY LOAMS, 03-08% SLOPES
49B		308	KEDRON SILT LOAM, 03-08% SLOPES
51B		396	LACKAWANNA CHANNERY LOAM, 03-08% SLOPES
51C		629	LACKAWANNA CHANNERY LOAM, 08-15% SLOPES
51D		645	LACKAWANNA CHANNERY LOAM, 15-25% SLOPES
51E		175	LACKAWANNA CHANNERY LOAM, 25-35% SLOPES
52B		2069	LAIDIG CHANNERY LOAM, 03-08% SLOPES
52C		405	LAIDIG CHANNERY LOAM, 08-15% SLOPES
52D		37	LAIDIG CHANNERY LOAM, 15-25% SLOPES
53B		54	LECK KILL CHANNERY SILT LOAM, 03-08% SLOPES
53C		70	LECK KILL CHANNERY SILT LOAM, 08-15% SLOPES
56C		26	LEW CHANNERY SILT LOAM, 08-15% SLOPES, STONY
58B		86	LILY LOAM, 03-08% SLOPES
58C	58D	171	LILY LOAM, 08-15% SLOPES
60B		103	LORDSTOWN CHANNERY SILT LOAM, 03-08% SLOPES
60D	60C	38	LORDSTOWN CHANNERY SILT LOAM, 15-25% SLOPES
62C		248	MANDY CHANNERY SILT LOAM, 08-15% SLOPES
62D		657	MANDY CHANNERY SILT LOAM, 15-25% SLOPES

DDRP: MID-APPALACHIAN REGION SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
62E	101D	1020	MANDY CHANNERY SILT LOAM, 25-35% SLOPES
62F		1922	MANDY CHANNERY SILT LOAM, 35-65% SLOPES
65B		392	MECKESVILLE CHANNERY LOAM, 03-08% SLOPES
65C		699	MECKESVILLE CHANNERY LOAM, 08-15% SLOPES
65D		371	MECKESVILLE CHANNERY LOAM, 15-25% SLOPES
67B	72B	600	MORRIS CHANNERY LOAM, 03-08% SLOPES
68B		53	MORRISON CHANNERY SANDY LOAM, 03-08% SLOPES
68C		83	MORRISON CHANNERY SANDY LOAM, 08-15% SLOPES
68D		64	MORRISON CHANNERY SANDY LOAM, 15-25% SLOPES
70B		71	CATOCTIN CHANNERY SILT LOAM, 03-08% SLOPES, STONY
70C		154	CATOCTIN CHANNERY SILT LOAM, 08-15% SLOPES, STONY
70D		480	CATOCTIN CHANNERY SILT LOAM, 15-25% SLOPES, STONY
71A		36	NOLO SILT LOAM, 00-03% SLOPES
72A		196	NORWICH CHANNERY LOAM, 00-03% SLOPES
73B		806	OQUAGA CHANNERY LOAM, 03-08% SLOPES
73C		728	OQUAGA CHANNERY LOAM, 08-15% SLOPES
73D		742	OQUAGA CHANNERY LOAM, 15-25% SLOPES
73E		92	OQUAGA CHANNERY LOAM, 25-35% SLOPES
74A		145	PALMS-CARLISLE MUCKS, 00-03% SLOPES
75A		247	PHILO SILT LOAM, 00-03% SLOPES
78A		23	POTOMAC VERY COBBLY FINE SANDY LOAM, 00-05% SLOPES
81Z		186	RUBBLE LAND
84C		44	SIMODA CHANNERY SILT LOAM, 08-15% SLOPES
86C		115	SWARTSWOOD CHANNERY LOAM, 08-15% SLOPES
87B		142	TRUSSEL-SIMODA COMPLEX, 03-08% SLOPES
90A		67	TYGART SILT LOAM, 00-03% SLOPES
92B		106	VOLUSIA CHANNERY SILT LOAM, 03-08% SLOPES
93D		72	WEIKERT CHANNERY SILT LOAM, 15-25% SLOPES
94B		1215	WELLSBORO-LACKAWANNA CHANNERY LOAMS, 03-08% SLOPES
94C		494	WELLSBORO-LACKAWANNA CHANNERY LOAMS, 08-15% SLOPES
94D		74	WELLSBORO-LACKAWANNA CHANNERY LOAMS, 15-25% SLOPES
96B		213	WHARTON SILT LOAM, 03-08% SLOPES
96C		84	WHARTON SILT LOAM, 08-15% SLOPES
97B		1473	WURTSBORO CHANNERY LOAM, 03-08% SLOPES
97C		302	WURTSBORO CHANNERY LOAM, 08-15% SLOPES
98B	88B	147	WYOMING GRAVELLY SANDY LOAM, 03-08% SLOPES
98D		69	WYOMING GRAVELLY SANDY LOAM, 15-25% SLOPES
100F		244	MANDY CHANNERY SILT LOAM, 35-65% SLOPES, STONY
103F		1075	CALVIN-LEHEW-DEKALB COMPLEX, 35-70% SLOPES, STONY
104C		134	CALVIN-LEHEW-DEKALB COMPLEX, 08-15% SLOPES
104D		260	CALVIN-LEHEW-DEKALB COMPLEX, 15-25% SLOPES
104E		268	CALVIN-LEHEW-DEKALB COMPLEX, 25-35% SLOPES
104F		709	CALVIN-LEHEW-DEKALB COMPLEX, 35-70% SLOPES
105D		255	NORTHCOVE CHANNERY LOAM, 15-25% SLOPES, STONY
105F		101	NORTHCOVE CHANNERY LOAM, 35-65% SLOPES, STONY
106E	106D	43	WALLEN VERY CHANNERY SANDY LOAM, 25-35% SLOPES
107F	107D	505	WALLEN VERY CHANNERY SANDY LOAM, 35-70% SLOPES, RUBBLY

DDRP: MID-APPALACHIAN REGION SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
108F		149	WALLEN-RUBBLE LAND COMPLEX, 35-70% SLOPES
109A		33	UDIFLUVENTS-FLUVAQUENTS COMPLEX, 00-05% SLOPES, FRIGID
110A		82	CRAIGSVILLE-FLUVAQUENTS COMPLEX, 00-05% SLOPES
111A		358	UDIFLUVENTS-FLUVAQUENTS COMPLEX, 00-05% SLOPES, MESIC
112C		555	SIMODA CHANNERY SILT LOAM, 08-15% SLOPES, BOULDERY
113C		59	TRUSSEL CHANNERY SILT LOAM, 08-15% SLOPES, BOULDERY
114F		197	MANDY-ROCK OUTCROP COMPLEX, 35-70% SLOPES
116D		17	ASHE LOAM, 15-25% SLOPES
116F		118	ASHE LOAM, 35-55% SLOPES
120D	20C, 20D	72	CALVIN-DEKALB COMPLEX, 15-25% SLOPES
126B		683	BUCHANAN CHANNERY LOAM, 03-08% SLOPES, STONY
126C		1090	BUCHANAN CHANNERY LOAM, 08-15% SLOPES, STONY
126D		104	BUCHANAN CHANNERY LOAM, 15-25% SLOPES, STONY
126E		233	BUCHANAN CHANNERY LOAM, 25-35% SLOPES, STONY
127C		314	MUSKINGUM SILT LOAM, 08-15% SLOPES
127D		138	MUSKINGUM SILT LOAM, 15-25% SLOPES
127F		272	MUSKINGUM SILT LOAM, 35-65% SLOPES
128F		56	KAYMINE VERY CHANNERY SILT LOAM, 03-70% SLOPES
130F		555	GILPIN CHANNERY SILT LOAM, 35-70% SLOPES, STONY
131B		12	ZOAR SILT LOAM, 03-08% SLOPES
132C		70	SHELOCTA SILT LOAM, 08-15% SLOPES, STONY
132E		321	SHELOCTA SILT LOAM, 25-35% SLOPES, STONY
135E		474	ERNEST-LAIDIG COMPLEX, 25-35% SLOPES
137E		680	LEW CHANNERY SILT LOAM, 25-35% SLOPES, RUBBLY
138F		1384	MYERSVILLE-CATOCTIN CHANNERY SILT LOAMS, 35-70% SLOPES, STONY
139D		33	CEDARCREEK CHANNERY LOAM, 15-25% SLOPES
151B		113	LORDSTOWN CHANNERY LOAM, 03-08% SLOPES, STONY
151C		90	LORDSTOWN CHANNERY LOAM, 08-15% SLOPES, STONY
152C		41	MECKESVILLE CHANNERY LOAM, 08-15% SLOPES, STONY
152D		303	MECKESVILLE CHANNERY LOAM, 15-25% SLOPES, STONY
152E		571	MECKESVILLE CHANNERY LOAM, 25-60% SLOPES, STONY
161B		424	GILPIN-RAYNE CHANNERY SILT LOAMS, 03-08% SLOPES
161C		620	GILPIN-RAYNE CHANNERY SILT LOAMS, 08-15% SLOPES
161D		300	GILPIN-RAYNE CHANNERY SILT LOAMS, 15-25% SLOPES
171B		84	HARTLETON CHANNERY LOAM, 03-08% SLOPES, STONY
171C		134	HARTLETON CHANNERY LOAM, 08-15% SLOPES, STONY
171D		95	HARTLETON CHANNERY LOAM, 15-25% SLOPES, STONY
172B		66	LAIDIG CHANNERY LOAM, 03-08% SLOPES, STONY
172C		77	LAIDIG CHANNERY LOAM, 08-15% SLOPES, STONY
181F		299	LORDSTOWN CHANNERY LOAM, 35-65% SLOPES, RUBBLY
182B		27	OQUAGA-ROCK OUTCROP COMPLEX, 03-08% SLOPES
182D		283	OQUAGA-ROCK OUTCROP COMPLEX, 15-25% SLOPES
182F		270	OQUAGA-ROCK OUTCROP COMPLEX, 25-65% SLOPES
184B	84B	102	SIMODA-TRUSSEL COMPLEX, 03-08% SLOPES
185Z		5	PITS, MINE
215D	15D	20	BLAIRTON-BERKS CHANNERY SILT LOAMS, 15-25% SLOPES

DDRP: MID-APPALACHIAN REGION SOIL LEGEND (continued)

MAP SYMBOL	ACCESSORY SYMBOL(S)	AREA (ACRES)	MAP UNIT NAME
242D	42D	22	LILY-GILPIN COMPLEX, 15-25% SLOPES
251D	151D	90	LORDSTOWN-OQUAGA COMPLEX, 15-25% SLOPES, STONY
253D	53D	163	LECK KILL-HAZLETON COMPLEX, 15-25% SLOPES
253F	53F	1010	LECK KILL-HAZLETON COMPLEX, 35-70% SLOPES
271B	71B	39	NOLO-ERNEST SILT LOAMS, 03-08% SLOPES
273F	73F	2228	OQUAGA-LORDSTOWN COMPLEX, 35-65% SLOPES

APPENDIX C:

DIRECT/DELAYED RESPONSE PROJECT: QUALITY ASSURANCE PLAN FOR MAPPING IN THE MID-APPALACHIAN REGION OF THE UNITED STATES

by

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1 SIGNATURE PAGE

QUALITY ASSURANCE PLAN FOR MAPPING ACTIVITIES OF THE DIRECT/DELAYED RESPONSE PROJECT IN THE MID-APPALACHIAN REGION OF THE UNITED STATES

Jeffrey Kern DDRP QA Coordinator	May 26, 1988 Date
Duane Lammers DDRP Mapping Task Leader	26 May 88 Date
M. Robbins Church M. Robbins Church EPA, DDRP Technical Director	6/6/88 Date
James McCarty James McCarty EPA Quality Assurance Officer	6/8/88 Date

2 LIST OF FIGURES

There are no figures.

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4 INTRODUCTION

QUALITY ASSURANCE (QA)

The quality assurance program of the US Environmental Protection Agency (USEPA) is designed to ensure that the collection of data by monitoring and measurement projects are scientifically sound, legally defensible, and of known quality. Every monitoring and measurement project must have a written and approved QA Project Plan to document the policies, organization, functional activities, and specific QA and quality control (QC) activities that are designed to achieve the data quality goals of the project. This document presents the QA plan for the mapping activities of the USEPA's Direct/Delayed Response Project (DDRP) in the Mid-Appalachian Region and the additional mapping in the Northeast (NE) Region. The mapping activities are part of the DDRP Soil Survey, which includes soil sampling and characterization. The protocols for these mapping activities are presented in Appendix A.

QA Requirements

It is the policy of the USEPA that each office or laboratory generating data must implement procedures to ensure that precision, accuracy, completeness, comparability and representativeness of data are known and documented (Quality Assurance Management Staff (QAMS), 1980). A written QA Plan is required to specify the quality levels that the data must satisfy to be acceptable for the intended use.

QA ELEMENTS

Nineteen elements (Table 1-1) must be included for consideration in a QA Project Plan (QAMS, 1980). The first two elements are a title page with provision for appropriate signatures and a table of contents. The other fourteen elements are sections two through sixteen in the table of contents.

Table 1-1 ELEMENTS OF A QA PLAN

Section	Element
1	Signature page
2	List of figures
3	List of tables
4	Introduction
5	Project description
6	Project organization and responsibility
7	QA objectives for measurement data in terms of accuracy, precision, completeness, representativeness and comparability
8	Sampling procedures
9	Sample custody
10	Calibration procedures and frequency
11	Analytical procedures
12	Data reduction, validation and reporting
13	Internal quality control checks and frequency
14	Performance and systems audits
15	Preventative maintenance
16	Specific routine procedures used to assess data precision, accuracy and completeness
17	Corrective actions
18	Quality assurance reports to management
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5 PROJECT DESCRIPTION

PROJECT DESIGN

Soil Mapping Design

Soil mapping standards are based on those of the National Cooperative Soil Survey (NCSS). Federal leadership of the NCSS is provided by the US Department of Agriculture - Soil Conservation Service (SCS). The standards are defined in the National Soils Handbook (Soil Survey Staff (SSS), 1983). The soil classification system used by the NCSS is Soil Taxonomy (SSS, 1975).

The intensity of this soil survey is order two, as defined by the SCS (SSS, 1983) which means that each map delineation is identified by traversing it and that the type of map units used are consociations, complexes, and, occasionally, undifferentiated groups. In this survey, the map scale is 1:24,000. The minimum size of delineations, which is the smallest size in which the map unit symbol can be printed easily, is about six acres; only hydric and alluvial soils are delineated at 2 to 6 acres. Small features are represented by special symbols.

Map units are collections of soils or miscellaneous areas grouped together to represent landscape units. Specifications of map units can be found in the National Soils Handbook (SSS, 1983). Map units are described in terms of ranges of soil characteristics and the types of similar and dissimilar soils commonly found within the unit. Similar soils share many properties and behavior which make them similar for the purposes of a survey, but differ by no more than two or three criteria that separate them from the principal soil according to Soil Taxonomy (SSS, 1975). Dissimilar soils differ in important diagnostic properties and/or use and management considerations. Areas of similar, dissimilar soils and miscellaneous areas found in a map unit, but not identified in the map unit name, are termed inclusions. Definitions (SSS, 1983) of the types of map units used in this survey are:

- consociations are map units in which at least 75 percent of the soils fit within the range of a given taxon or miscellaneous area. The amount of dissimilar inclusions should not exceed 15 percent.
- complexes are map units in which two or more kinds of soil occur in a pattern that repeats; but is so intricate that components cannot be separately delineated at the mapping scale specified. Each named component of the complex occupies a significant portion of the delineation. No single dissimilar soil should occupy more than 10 percent of the area and all dissimilar soils combined should not exceed 15

percent. In the name of a complex the named soils are combined with a dash.

- undifferentiated groups are map units in which two or more kinds of soil occur but are not consistently found in regular patterns. The components are similar soils with similar uses. Each delineation need not have all the components present. No single dissimilar soil should occupy more than 10 percent of the area and all dissimilar soils combined should not exceed 15 percent.

The descriptive legend is designed to be uniform and consistent for the entire region. The descriptive legend is composed of three parts: descriptions and classification of soils, an identification legend and a conventional and special symbols legend. The description and classification of soils section contains information about taxonomic units (components of map units). Taxonomic units are described by name, parent material mode of deposition and origin, depth to bedrock, depth to restricting layers, drainage class, permeability, hydrologic group and taxonomic classification. The identification legend consists of a list of symbols to identify soil map units. The conventional and special symbols legend consists of symbols used to identify artificial works and structures, boundaries and drainage. Included are symbols for identifying areas of soil, special features or miscellaneous areas too small to be delineated at the scale of mapping.

Map unit descriptions contain the map symbol, name of the map unit, dominant landforms and geomorphic positions commonly found on, slope configuration, soil components with percent estimates and additional notes.

Depth to Bedrock Mapping Design

Survey parties prepare depth to bedrock maps based on the depth of the mapped soils. The party estimates depth to bedrock from examination of soils, roadcuts, excavations and stream incisements. The mapping is transferred to mylar overlays on a USGS quadrangle or orthophotoquad at a scale of 1:24,000. One to three depth classes are assigned to each map delineation. The depth to bedrock classes should reflect major soils in the delineation, not map unit inclusions. The depth to bedrock symbol for a map delineation lists the depth to bedrock classes in descending order of estimated extent. Adjacent map delineations with the same depth to bedrock symbol(s) are combined for the final map. Where appropriate a soil map delineation may be segmented into more than one depth to bedrock class.

Landuse and Forest Cover Mapping Design

Survey parties prepare landuse and forest cover maps from field study. The mapping is transferred to mylar overlaying USGS quadrangles or orthophotoquads at a scale of 1:24,000. Landuse is designated by the landuse codes used on the SCS Soil Description Form. Forest cover numeric codes used are those of the Society of American Foresters (Eyre, 1980).

Drainage

Drainage features maps are prepared on mylar overlays on a USGS quadrangle or orthophotoquad at a scale of 1:24,000. Standard map symbols shown in the mapping protocols (Lammers et al, 1988) are used to show all perennial streams, dominant (well-defined) intermittent streams, water bodies and other water features. Marsh or swamp symbols are used to show areas less than two acres with standing water; larger marsh or swamp areas are delineated on the overlay and labelled "S". The upper end of perennial streams are marked with short red lines across stream symbols. If using a USGS topographic map care should be exercised to make any corrections to changes in drainage since the original topographic map was prepared.

6 PROJECT QUALITY ASSURANCE (QA) ORGANIZATION AND RESPONSIBILITY

PROJECT ORGANIZATION

The Mapping Task Leader from ERL-C had overall responsibility for the field activities and the documentation of methods, field operations, and data quality. The Mapping Task Leader maintained the mapping information database that contains the identification legend, the classification, and description of map unit composition.

The RCC was an independent contractor who provided QA/QC oversight for the fieldwork. The RCC maintained a uniform, consistent regional mapping legend, participated in at least one field review for each state as an audit of field mapping procedures and mapping quality, and evaluated the quality of the mapping in 20 percent of the watersheds.

The SCS State Soil Scientists for ME, NY, and PA, with the support of the State Soils Staff, were responsible for the field activities by personnel from their state. This included supervising and coordinating field crews, conducting at least one progress field review as an audit of each soil survey party, working with the RCC to ensure regional consistency, forwarding completed maps with field notes to the Mapping Task Leader, and participating in training field crews.

The DDRP ERL-C QA Coordinator worked with the QA Staff of ERL-C to coordinate and document QA/QC activities. The QA Coordinator evaluated final map quality with the Mapping Task Leader, helped coordinate the QA/QC activities of ERL-C geographers, and was responsible for the preparation of the Field Operations and QA report.

The Soil Survey Parties, led by a soil scientist, mapped the watersheds, described soils and soil map units, and conducted transects across map delineations to determine map unit composition.

PROJECT RESPONSIBILITY

Soil Survey Parties

The soil scientists assigned to conduct the mapping had the following responsibilities:

- conducted field investigations and aerial photo interpretation in order to delineate map units,
- traversed or visited all map delineations in the field,
- recorded observations and problems systematically in field notes, and

- conducted randomly selected transects used in the determination of soil map unit composition.

USDA-SCS State Soils Staffs

The State Soils Staffs had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- trained soil survey parties in and supervised adherence to the mapping protocols,
- conducted field reviews that were to include at least one watershed for each mapper,
- reported and resolved mapping problems in an expeditious and uniform manner,
- conducted follow-up reviews to ensure that any necessary corrective actions had been taken,
- prepared reports presenting results of the above tasks, and
- reviewed mapping products and sent the products to ERL-C.

Regional Coordinator/Correlator (RCC)

The Regional Coordinator had the following responsibilities:

- maintained a uniform and controlled legend by coordinating and correlating soils and map units,
- participated in training,
- conducted transects on selected map units to evaluate the correctness of the mapping,
- evaluated mapping on about 20 percent of the watersheds by aerial photography interpretation and field investigations,
- participated in at least one progress review for SCS personnel in each state,
- evaluated state field review reports (Appendix D), and
- prepared reports presenting the results of the above tasks.

Mapping Task Leader

The Mapping Task Leader had the following responsibilities:

- managed and directed the mapping,
- worked with the DDRP ERL-C QA Coordinator to coordinate and document QA/QC activities,
- developed mapping protocols,
- provided initial instruction on mapping activities,

- evaluated progress reviews,
- coordinated with the SCS and the RCC to ensure that any necessary corrective actions were taken to resolve identified problems,
- selected watersheds and transects to be evaluated by the RCC,
- received and stored all interim and final reports, maps and other products,
- supervised final map checks and corrective actions before maps were digitized, and
- maintained the mapping database.

QA Coordinator

The DDRP ERL-C QA Coordinator had the following responsibilities:

- prepared the QA Plan,
- evaluated final map products,
- coordinated review of final map with geographers,
- worked with the ERL-C QA Staff to ensure that QA requirements were being fulfilled
- facilitated the exit meeting, and
- prepared the Field Operations and QA Report.

7 PROJECT QA OBJECTIVES

The intent of the USEPA QA program is to ensure that data are collected that are scientifically sound, legally defensible, and of known quality (QAMS, 1980). Fields reviews which function as audits, transects across map delineations by the RCC and evaluation of the mapping by the RCC will be used to assess the quality of the field mapping.

DEFINITION OF QA OBJECTIVES

Quality assurance objectives are defined in terms of the following characteristics (QAMS, 1980):

- Accuracy
- Precision
- Representativeness
- Completeness
- Comparability

Accuracy and Precision

Accuracy is the degree of agreement of a measurement (or an average of measurements) with an accepted reference or true value. Accuracy is the degree to which mapping describes the true condition of watershed attributes. The accepted reference values used in this project are the expert judgments of the RCC and the State Soils Staff. Accuracy is affected by the scale and order of survey because different levels of detail are required at different scales.

Precision is a measure of mutual agreement among individual measurements of the same property. In analytical laboratory work, precision is the agreement of measurements on a sample made by the same lab and/or different labs. For a soil mapping project, precision cannot be defined in the same manner, because only one survey party maps a given delineation. If one considers map units with similar properties in different geographical locations as a property for comparison, then precision would be defined as how consistently mappers identify that map unit in different locations.

Completeness, Representativeness, and Comparability

Completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population. Comparability is the confidence with which one data set can be compared with another.

DATA QUALITY OBJECTIVES (DQOs)

Mapping DQOs

Accuracy and precision are addressed in this section in general terms and are discussed more specifically in the following section. Representativeness, completeness and comparability are discussed in this section only because they are applied to the mapping activity as a whole.

Accuracy and Precision –

To assess accuracy for the mapping activities, the accepted reference or "true value" is considered to be the expert judgement of the RCC and State Soils Staff. The accuracy of a map delineation is its degree of conformity to the landscape. The accuracy of a map unit is its degree of conformity with the composition of soils or other watershed attributes in delineated areas (ground truth). For a map to accurately reflect the condition that is being mapped, the mapper must select the appropriate map unit to describe the watershed attribute and draft the appropriate map delineation boundaries.

Precision, for these mapping activities, is the degree of agreement between different mappers if they were to map a given attribute for the same or similar landscapes. In this project only one survey party maps a given area, thus, what is important in terms of precision, is that similar landscapes be mapped in the same manner. Training, adherence to protocols, and oversight by the RCC and the State Soils Staff ensures that watershed attributes are mapped consistently. Accuracy and precision are discussed below for each type of map overlay.

Representativeness --

Representativeness, for this project, is the degree which the mapping data collected accurately represents the actual condition of watersheds mapped. Procedures for ensuring representativeness are considered in the project design phase (Church et al., 1989).

Completeness --

The completeness objective for this project is 100 percent. If the mapping in any watershed is determined to be unacceptable by the RCC or State Soil Staff, then the watershed must be remapped. One situation that might limit attaining 100 percent completeness, is if mappers are denied access by property owners. Mappers must make every effort to gain watershed access including use of a letter from the USEPA to the landowner explaining the project or enlisting the help of local people to talk with landowners.

For the mapping data to be complete, the final map products delivered to ERL-C must be accompanied by supporting documentation. This documentation contains descriptions of map units supported by a minimum of one field note for each map unit on the watershed and a minimum of two pedon descriptions for each kind of soil series mapped. A copy of the Official Soil Series Description for each series mapped with the ranges of characteristics adjusted to reflect the soils mapped in the region are submitted. Transect data are submitted for randomly selected, 10-point transects for each different map unit on a watershed (all map units if 10 or less, otherwise the number of transected map units is 10 plus half the number of units greater than 10).

Comparability --

Comparability of mapping of one watershed to another within this soil survey is ensured by adherence to the same mapping protocols by all field crews with QA/QC checks by the RCC and State Soils Staff. Training field personnel about the protocols helps assure uniform interpretation and application of the mapping protocols. Comparability within a region is promoted by the use of uniform map legends.

The methods used in this soil survey make it comparable with the other DDRP soil surveys even though the surveys have different map legends and kinds of soil. Comparability of mapping in the DDRP Mid-Appalachian Soil Survey to DDRP soil surveys in the Northeast Region and Southern Blue Ridge Province is maintained by using the same general NCSS guidelines, the same scale and the same order survey. The major difference between this survey and other DDRP soil surveys is that the minimum size delineation in this survey for hydric and alluvial soils is 2 acres; whereas, in the Northeast and Southern Blue Ridge surveys the minimum delineation for all kinds of soils is 6 to 10 acres. Adherence to NCSS standards makes all the DDRP soil surveys comparable to soil mapping conducted by the NCSS.

Depth to bedrock mapping in the past DDRP surveys used the same legend and approach. Mapping activities in the Northeast did not include land use mapping by the soil survey parties. Bedrock geology for the past surveys was determined directly from state geology maps. State geology maps were used to determine bedrock geology for this survey.

Soil Mapping DQOs

Accuracy and Precision –

The quality objectives for soil mapping accuracy are that the mapper consistently choose the most appropriate map unit and that the map delineation boundary is drawn in the appropriate location. Map units are established using NCSS guidelines discussed in Section 5. If the mapper observes landscape units that do not fit the concept of any map unit on the legend, then either it is correlated to a similar map unit, or a new map unit is established. The accuracy of soil map delineation boundaries depends upon the use of landscape features that reflect the pattern of soils. For example, slope changes, drainage differences or vegetation may reflect the boundaries between different landscape segments that have different soils. Accuracy in soil mapping requires the use of such features, while mapping precision requires that when such relationships are observed, they are uniformly applied in the survey area.

Depth to Bedrock Mapping DQOs

Accuracy and Precision --

Observations made by the survey parties to estimate depth to bedrock classes are normally limited to observations while examining soils, road cuts, and stream incisements. The mappers delineate the depth to bedrock classes that correspond with the major soils in the map unit delineation. Soil surveys in populated areas can use well logs and road department drill logs to estimate depth to bedrock. Data of this type may not be available for watersheds in this survey however. The type of observations available give a good indication of the depth to bedrock where the bedrock is not extremely deep.

At two meters or less depth, the mapper should have enough information to accurately assess the depth to bedrock. Depth values should be as accurate as the soil mapping. At 2 to 5 m depth, the expected accuracy is lower than that above 2 m. At depth greater than 5 m, it is difficult to assess the accuracy of the mapper without coring equipment, ground penetrating radar or some other special technique that is outside the scope of this survey.

The assessment of accuracy and precision for depth to bedrock mapping is primarily done by the expert judgement of the RCC and State Soils Staffs with an additional check done by the evaluation of transect data.

Landuse and Forest Cover Mapping DQOs

Accuracy and Precision --

The mapping crews should have enough information available to determine landuse and forest cover. Direct observation can also be used to delineate landuse to the same accuracy as soil mapping. Survey party members must be trained to correctly identify landuse and forest map units.

Drainage Maps DQOs

Accuracy and Precision --

The accuracy goal for drainage maps is that they accurately reflect stream and water features as they occur at the time of mapping. USGS topographic maps may be used to aid in mapping.

The final drainage map should reflect field observation and aerial photo interpretations to account for possible changes that have occurred since the USGS maps were produced.

8 SAMPLING PROCEDURES

There are no sample collection activities required for the soil mapping activities.

9 SAMPLE CUSTODY

No samples are collected for soil mapping activities, and sample custody is not an issue.

10 CALIBRATION PROCEDURES AND FREQUENCY

There are no calibration procedures involved in soil mapping activities. The transects surveyed by the soil mappers is a type of calibration activity. In the course of mapping, a mapper chooses their own way of traversing and examining the landscape. Transects that were randomly chosen are a way of comparing the traverse chosen by the mapper. This functions as a calibration activity because transect observations may be different than the mapper's observations during mapping and can indicate that more field checking may be necessary.

Field reviews serve a calibration function by comparing the mapper's observations with other experienced soil scientists. The judgments of the review team also serves as a calibration or reference against which the mapper can compare observed pedon characteristics which the mapper uses for selecting map units and landscape interpretations. A crucial tool for accurate and precise placement of map delineation boundaries.

11 ANALYTICAL PROCEDURES

There are no analytical procedures involved with the soil mapping activities.

12 DATA REDUCTION, VALIDATION AND REPORTING

TRANSECT DATA

Transect data, from the survey parties (routine transects), will be used to determine map unit compositions. RCC transects will be used to evaluate the accuracy of map unit compositions and the accuracy of the mapping. Transect data will be entered into a data base at ERL-C. Map unit symbols and names will be corrected to reflect changes caused by correlation.

SUPPORTING DOCUMENTATION

Documentation must contain descriptions of map units supported by a minimum of one field note, which is a brief soil profile description, for each map unit on the watershed and a minimum of two pedon descriptions for soil series mapped. A copy of the SCS Official Soil Series Description for each series mapped adjusted to reflect the soils mapped in the region must be submitted to the Mapping Task Leader at ERL-C.

FINAL MAP PRODUCTS

All final maps must be prepared on mylar overlays registered to a 1:24,000 scale topographic map or orthophotoquad base map. Final maps showing transects accompanied by supporting documentation are submitted to the Mapping Task Leader.

13 INTERNAL QC CHECKS AND FREQUENCY

INTERNAL QC CHECKS BY SOIL SURVEY PARTY

The Survey Party Leaders have responsibility for adherence to mapping protocols and the performance of all mapping activities. As discussed above in Section 7 (Calibration), the transects done by the mappers serve a calibration function and as an internal QC check to identify problems as they occur.

14 PERFORMANCE AND SYSTEMS AUDITS AND FREQUENCY

AUDITS BY STATE SOILS STAFFS

To audit mapping parties, the State Soils Staffs will conduct at least one field review of watershed mapping for each survey party in accordance with guidelines for field reviews of the NCSS (SSS, 1983). A written report will be submitted to the RCC and ERL-C on the Field Review Report Form (Appendix A). Any deviations from mapping protocol found, including suggested and completed corrective actions must be reported to the RCC and ERL-C immediately.

AUDITS BY RCC

The RCC will participate in and document at least one progress field review of SCS personnel from each state. In addition, the RCC will review all the field review reports.

15 PREVENTATIVE MAINTENANCE PROCEDURES AND SCHEDULES

It is the responsibility of the State Soils Staff to keep the survey parties well supplied with necessary equipment and to maintain any equipment.

16 SPECIFIC ROUTINE PROCEDURES TO ASSESS QA OBJECTIVES

MAPPING EVALUATION BY THE RCC AND STATE SOILS STAFFS

The RCC independently evaluates mapping in about 20 percent of the watersheds as chosen by the USEPA. Twenty percent of the map delineations in selected watersheds are transected by the RCC. The RCC examines aerial photographs of the watersheds and traverses 20 to 50 percent of the map units. The RCC also participates in field reviews.

The State Soils Staff conducts at least one field review of watershed mapping for each survey party in accordance with NCSS guidelines for field reviews (SSS, 1983). Results of all field reviews should be documented and submitted to ERL-C.

ANALYSIS OF TRANSECT DATA

The transect data are evaluated in several ways. The proportions of all major components of the map units are estimated from routine transects. Transects done by the RCC will be compared with the map unit compositions estimated by the mappers using binomial distribution or the normal approximation to the binomial.

The map unit composition calculated from routine transects are compared to those of the RCC using Fisher's exact test (Fisher, 1935). This provides a check on the accuracy the selection of the map unit chosen for the map delineation. This also provides an indication of the accuracy of the map unit descriptions. The proportions of major components of map units determined from routine transects may have to be adjusted if there are significant differences between the RCC and routine transects.

FINAL MAP CHECKING AT ERL-C

A final check of map quality is done at ERL-C prior to digitization of the data. Soil scientists examine the maps to ensure that correct map symbols were used, that patterns of delineation follow the landscape, that the depth to bedrock classes agree with the soil depth classes and that slope classes generally agree with topographic maps. Geographers evaluate tic marks and registration, watershed boundaries, stream placement and the fit of the mapping to the geomorphology. The quality of landuse and forest cover mapping is evaluated by a forest soil scientist.

17 CORRECTIVE ACTION

The State Soils Staff makes recommendations to mappers on how to conform with protocols during field reviews and any deviations from protocols must be reported immediately to ERL-C. Major deviations may cause the State Soils Staff to recommend that areas be remapped. It is the responsibility of each State Soils Staff, in consultation with the RCC and the Mapping Task Leader, to determine what corrective actions are appropriate. Corrective actions that arise from field reviews are specified on the Field Review Report Form (Appendix A) and the reviewer makes sure that the corrective action has been done. Most of the corrective actions occur at the time of field reviews. The State Soils Staff must follow through to correct similar deficiencies on other watersheds.

The RCC is expected to make recommendations to mappers concerning the implementation of mapping protocols. The RCC must report mapping problems to ERL-C immediately and recommend corrective actions be taken. The RCC can recommend that remapping be done if there is a need.

The Mapping Task Leader and ERL-C will coordinate with the SCS and the RCC to ensure that necessary corrective actions are carried out. Corrective actions indicated by the final map checking process at ERL-C, require that the field mappers first be contacted for clarification. The Mapping Task Leader is responsible for assuring and documenting any corrective actions that are taken.

18 QA REPORTS

REPORTS OF THE STATE SOILS STAFFS

The State Soils Staff will submit Field Review Report Forms and any other supplemental documentation to ERL-C. The RCC and ERL-C will be contacted immediately if deviations from protocol are discovered.

REPORTS OF THE RCC

The RCC must prepare written reports and submit them to ERL-C regarding the evaluation of 20 percent of the watersheds mapped, review of state field review reports and the transects on selected watersheds. In the case of serious discrepancies, the RCC should contact ERL-C immediately.

FINAL QA REPORT

At the completion of the soil mapping activities the Soil Mapping Task Leader and ERL-C will prepare a final QA report documenting QA issues and the quality of the final map products.

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APPENDIX D:

DIRECT/DELAYED RESPONSE PROJECT: REGIONAL COORDINATOR/CORRELATOR QUALITY ASSURANCE REPORT FOR MAPPING IN THE MID-APPALACHIAN REGION OF THE UNITED STATES

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1 REVIEW AND COMMENTS ON FIELD REVIEW REPORTS

In reviewing the reports by the US Department of Agriculture, Soil Conservation Service (SCS), State Soils Staffs, comments have been made only on the reports as written. Comments are not made based on Regional Coordinator/Correlator's (RCC's) findings where the same watershed was reviewed or evaluated. Comments are only on the adequacy and completeness of the reports as written.

WEST VIRGINIA REPORTS

Thunderstruck Creek, Watershed ID 2C041040

The review of the watershed was conducted on June 1, 1988, in conjunction with a review by the RCC. The map adequacy check form shows that five different map units were checked. The report includes a copy of the soil map that shows nine map delineations which is 56 percent of map delineations. All applicable questions on the report were answered. The review report does not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review.

Section 2.2.2 of the review form states that map unit notes are available for each map unit, but the RCC found that map unit worksheets were not complete. A check of transect data indicates that map units were correct. Three soil components of map units were described in the watershed and all were adequate and correct. There were no deficiencies noted in the report. The reviewer stated that a field check of unit 109A showed that the map unit should be named Udifluvents-Fluvaquents rather than Fluvaquentic Dystrochrepts-Fluvaquents complex. Descriptions were obtained for use in updating the map unit description. Other areas were found to be correct as mapped.

The review examined the mapping quality in accordance with the mapping protocols. The report indicates that all aspects of mapping were checked. The map adequacy check form did not give deviations from the expected, but gave review comments for each stop. The review report adequately documented that the mapping was of acceptable quality.

Crawford Run, Watershed ID 2C047007

The review of the watershed was conducted on May 18, 1988. The review did not include a map adequacy check form and therefore there was no indication of the number of delineations examined. All applicable questions on the report form were answered. The report does not state that any issues of protocol, mapping, correlation or transecting were brought up during the review.

Section 2.2.2 of the review form states that map units were documented on transect sheets, but indicated that additional work was needed on the map unit work sheets. The review report does not indicate if mapping notes were available or checked. Review of transect notes indicated that transects verify the accuracy of the map unit. Six soil components of map units were described in the watershed and were found to be adequate and correct.

There were no deficiencies noted in the report; however, it was stated in Section 4.1 and 4.3 that some changes were made on the soil map and the maps were returned to the field for revision. The corrective action was completed June 1, 1988. The review examined the mapping in accordance with the protocols except for the inclusion of a map adequacy check form. There is no indication of the number of delineations in the watershed or the number checked. The review report adequately documents that the mapping is of acceptable quality.

PENNSYLVANIA REPORTS

East Branch Wallis Run, Watershed ID 1D029031

A review of the watershed was conducted on June 20 and 21, 1988, in conjunction with a review by the RCC. The review did not include a map adequacy check form; however, the cover letter indicates that 9 stops were made on 6 different map units with 3 stops on 1 map unit. All applicable questions were answered. The report did not state that any issues of protocol, mapping, correlation, or transecting were brought up during the review.

The review report included notes made at each review stop. Section 2.2.2 states that map unit sheets were complete and accurate for the watershed and indicated map unit notes will be used for an up-date of map unit descriptions. The review report did not indicate if field notes were available or checked. Review of available transect data (transecting had not been completed) verified that map units were correct. No soil components of map units were described in the watershed.

The report indicated 2 noted deficiencies; 1 involved landuse and cover type maps which were not completed, and 1 unspecified change on the soil map. Section 4.2 of the report indicated that the changes were made but did not give the date. The review examined the mapping in accordance with protocols except for the inclusion of a map adequacy check form. There was no indication of the total number of map delineations in the watershed. The review report adequately documented that the mapping is of acceptable quality with only minor revisions needed.

Boyers Run, Watershed ID 2B036028

A review of the watershed was conducted on June 27 and 29, 1988. The review report did not include a map adequacy check form; however, the cover letter indicated that 8 transects were made with a total of 17 stops. The stops were on seven different map units. It was not clear from the report if there were 17 stops on l7 different map delineations. All applicable questions were answered. The report did not state that any issues of protocol, mapping, correlation, or transecting were brought up during the review.

The report included detailed notes made at each stop during the review. Section 2.2.2 indicated that map unit sheets were complete and accurate for the watershed. The review report did not indicate if field notes were available or checked. Review of transect data verified that map units were correct. Four soil components of map units described in the watershed were found to be adequate and correct.

The report states that no deficiencies were noted; however, there were different interpretations of cover type requiring changes in cover type and cover type boundaries. One delineation required a change of slope class. Corrective actions were completed June 29, 1988. The review examined mapping quality in accordance with protocols except for the inclusion of a map adequacy check form. There was no indication of the total number of map delineations in the watershed. The review report adequately documents that the mapping was of acceptable quality.

Piney Creek, Watershed ID 2B041008

The review of the watershed was conducted on July 18 and 19, 1988. The review did not include a map adequacy check form; however, the cover letter indicated that 21 stops were made on 7 different map units. All applicable questions were answered. The report did not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review.

The cover letter for the report stated what was done on the review and includes reviewers' notes made at each review stop. Section 2.2.2 states that map unit sheets are complete and accurate for the watershed and that notes were on transect data sheets. The review report did not indicate if field notes were available or checked. Review of transect data verified that map units were correct. Two soil components of map units were described in the watershed and found to be adequate and correct.

The only deficiencies noted were lack of trails, roads, cabins, farmsteads, and gas wells marked on the landuse overlay. These were to be added by the team leader and the report stated that this was done July 21, 1988. The review examined the mapping in accordance with protocols except for the inclusion of a map adequacy check form. There was no indication of the total number of map delineations in the watershed. The report adequately documented that the mapping is of acceptable quality.

Fulton Run, Watershed ID 2C041002

The review was conducted on July 20, 1988. The review did not include a map adequacy check form; however, the cover letter indicated that 8 stops were made on 4 different map units. All applicable questions were answered. The report did not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review. The report stated that one landowner denied access to map and that the team leader had apparently accurately extended soil boundary lines through the property based on observations on adjacent land.

The cover letter included notes made at each review stop. Section 2.2.2 stated that information on the map unit work sheets was yet to be completed. Reviewers notes referred to mappers notes documenting features of the watershed. A review of transect data verified that map units are correct and stated that 3 units were not transected due to landowner refusal to grant permission to cross his land. No soil components of map units were described in the watershed.

The report stated that there were "a few small minor cartographic discrepancies noted" and that corrections were made at the review. The report did not give the nature of the discrepancies. The review examined the mapping in accordance with protocols except for the inclusion of a map adequacy check form. There is no indication of the total number of delineations in the watershed. The report adequately documented that the mapping is of acceptable quality.

Whitney Run, Watershed ID 2C028069

The review was conducted on July 27 and 28, 1988. The review does not include a map adequacy check form, however the cover letter indicated that 6 stops were made on 5 different map units. All applicable questions were answered. The report did not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review.

The cover letter includes notes made by the reviewer at each review stop. The report did not include any field notes by mapping crew leader, soil descriptions or map unit descriptions. Section 2.2.2 stated that map unit worksheets were complete and correct for the watershed. The review report did not indicate if field notes were available or checked, but Section 4.4 states that available information should be included in the map unit or free form notes. A review of transect data verified that the map units were correct. No soil components of map units were described in the watershed.

The only deficiency noted was the use of a short-steep-slope symbol for an area that should have been mapped out. Corrective action was completed July 28, 1988. The review examined the mapping in accordance with mapping protocols except for the inclusion of a map adequacy check form. There was no indication of the total number of delineations in the watershed. The report adequately documented that the mapping was of acceptable quality.

East Big Branch Run, Watershed ID 2C029016

The review was conducted on July 14, 1988. The review does not include a map adequacy check form. The cover letter states that at least one examination was made of each map unit. The number of stops is not given in the report. All applicable questions were answered. The report did not indicate that any issues of protocol, mapping, correlation or transecting were brought up during the review.

The review report did not include any field notes by the mapping crew, soil descriptions or map unit descriptions. Section 2.2.2 stated that map unit sheets were complete and correct for the watershed. The cover letter stated that field notes are in order. A review of transect data verified that the map units were correct. Four soil components of map units were described in the watershed and found to be adequate and correct.

The report stated that there were no deficiencies noted. The review examined mapping quality in accordance with protocols except for the inclusion of a map adequacy check form. There is no indication of the total number of map delineations in the watershed. The review adequately documented that the mapping is of acceptable quality.

2 INITIAL REGIONAL CORRELATOR/COORDINATOR FIELD VISITS

The initial field visits by the RCC were conducted during the fall of 1987. On September 9 and 10, 1987, a visit was made to Bedford, PA, to participate in a workshop to prepare the first draft of the mapping legend for the Mid-Appalachian survey. Representatives of the SCS from PA and WV attended.

During the workshop the first draft of the mapping legend was completed, map unit symbols were assigned, and the preliminary map unit and component work sheets were completed. The group also prepared the conventional and special symbols legend.

On September 30 to October 2, 1987, the RCC met at Parsons, WV, with the principal SCS mappers from WV and one mapper from PA for detailed training on mapping protocols. The training was conducted by personnel from the US Environmental Protection Agency (USEPA) Environmental Research Laboratory in Corvallis, OR (ERL-C). The training was primarily for WV personnel as they were not previously involved in DDRP projects.

On October 26, 1987, the RCC met with all involved SCS personnel from WV at Parsons, WV. At this point, only two preliminary watersheds had been mapped. These were the same watersheds visited on October 1, 1987, during the initial protocol training. A second field visit was not made during the latter meeting.

All map products were completed on the 2 preliminary watersheds by the 2 mapping teams. The visit consisted of a review of the map products and a discussion of the mapping protocols. This was a very effective session because each team had completed all work on a single watershed and had an opportunity to work with the mapping protocols and determine what, if any, questions they might have. Also, the teams used the opportunity to make suggestions for protocol changes. No work was done in PA on the Mid-Appalachian survey project in the fall of 1987 and an initial field visit was not necessary.

3 RCC FIELD REVIEWS

Two formal RCC progress field reviews were made in the DDRP Mid-Appalachian Region. One was on Thunderstruck Creek, Watershed ID 2C041040 in Preston County, WV and the other was for East Branch of Wallis Run, Watershed ID 1D029031 in Lycoming County, PA. Copies of the field review report forms were sent to the DDRP Mapping Task Leader, ERL-C in July 1988.

COMMENTS FROM REVIEW OF THUNDERSTRUCK CREEK, WV

A progress field review was made June 1 and 2, 1988. Notes made during the review are as follows:

Site 1. Checked narrow delineation of 41C along watershed boundary to observe transect route. The area, being very narrow, was impossible to transect at right angles to the drainage. The area was correctly mapped and was transected by a zig-zag route which was appropriate under the circumstances.

Site 2. Looked at area of 41E (Gilpin). The area was correctly mapped. The team leader wanted to rename the unit as very channery silt loam. Where checked, the surface horizon contained < 35 percent rock fragments. After discussion, it was decided to rename units of 41 as Gilpin channery silt loam and consider areas with < 15 percent and > 35 percent rock fragments as inclusions.

Site 3. Checked area mapped 41D. The area was found to be appropriately mapped.

Site 4. Checked 2 sites along approximate location of mapping teams transect of unit 41F. The first site was used to typify the Gilpin series. The soil was correct as described but upon close examination, extended depth of the typical pedon was extended to 74 cm and a C horizon with 80 percent rock fragments was added.

Site 5. Checked another site along 41F transect near bottom of ridge. The area was correctly classified as 41F.

Site 6. Made random traverse on unit 109A. Fluvaquents-Fluvaquentic Dystrochrepts complex. Most better drained areas checked on the traverse appeared to better fit Udifluvents (both Typic and Aquic). Recommended that unit be renamed Fluvaquents-Udifluvents complex, frequently flooded. The area was appropriately mapped with respect to riparian areas. Looked at additional areas of 41F on returning up ridge to the cars.

June 2, 1988, was devoted to an in-office check of other map products which were found to be complete and correct. Also made a stereoscopic check of the aerial photos of the watershed. There were no deficiencies noted or corrective actions required in the watershed. The mapping was found to be acceptable.

Map unit work sheets were not completed for the new units; however, the team leader had made an excellent set of notes that provided information for future preparation of map unit work sheets. The team leader had done a commendable job in preparing notes. One set covered the general nature of the watershed and another set covered all map units in the watershed. Five of nine map delineations were examined during the review.

COMMENTS FROM REVIEW OF EAST BRANCH OF WALLIS RUN, PA

A progress field review was made June 20 and 21, 1988. Notes made during the review are as follows:

Site 1. Checked area mapped 51B (Lackawanna). Checked 2 pits and both were correct as mapped. Forest cover type had been shown as 27 (sugar maple) but American beech and yellow birch were codominant and the area should have been mapped as 25.

Site 2. Checked area mapped 94B (Wellsboro). The area was correctly mapped. Lowest parts of landscape include small areas of Morris.

Site 3. Checked area of alluvial soils along main stream in watershed. The area was mapped 173A. The unit had not been named, but was thought to be a complex of well drained to poorly drained alluvial soils. Decision made to name area Fluvaquents - Udifluvents complex and correlate with similar unit checked during the review in WV.

Site 4. Checked area mapped 51E (Lackawanna). The area was correctly mapped.

Site 5. Checked area mapped 73E (Oquaga). The area was correctly mapped. Includes small area of Arnot. The site was in an old field that had been mapped as cropland. Part of the area better classifies as pasture and part as white pine forest.

Site 6. Checked area mapped 97B (Wurtsboro). The unit contained a mappable area of Oquaga. Also, where checked, the soil better fit the concepts of Wellsboro.

Site 7. Checked area mapped 22A (Carlisle). The area was correctly mapped. The area included a narrow band of Palms muck around the edges of the delineation. Cover type designation in this type area is a problem. The area is mostly high bush blueberries with a few hemlock, yellow birch and white pine. This vegetation is not a listed forest cover type.

Site 8. Checked area mapped 86C (Swartswood). The site was near a drainageway and the soils were moderately well drained and were reddish colored and a better fit for Wellsboro.

Site 9. Same delineation as stop 8. The soil at this site is a good fit for Swartswood.

Site 10. Same delineation as above. Good fit for Lackawanna. Decision made to change all Swartswood to Lackawanna and all Wurtsboro to Wellsboro in this watershed.

June 21, 1988 was devoted to an in-office check of available materials and a completion of the review report. This session provided an opportunity to answer questions and discuss mapping protocols. The first draft of the soil map was completed at the time of the progress review. Other map products were not complete. Five of 9 transects had been completed. Those completed verified that the map units are correct.

Deficiencies noted were incorrect forest cover types and landuse in two places and the omission of a small mappable area of Oquaga soils in an area mapped Wurtsboro. Required corrective actions were made during the review and no further actions were required. The mapping was found to be of acceptable quality.

4 RCC INDEPENDENT EVALUATION OF WATERSHED MAPPING

QUALITATIVE EVALUATION

Twenty percent of the watersheds in the DDRP Mid-Appalachian Region were selected randomly by USEPA personnel for the RCC independent evaluation of watershed mapping. Watersheds were randomly selected by the Mapping Task Leader to ensure that at least one watershed was evaluated for each mapping crew. This represents 8 watersheds distributed as follows: 2 in WV, 5 in PA, and 1 in VA. SCS personnel in WV were responsible for mapping the watersheds in VA.

Each SCS state office provided the RCC with materials needed for map evaluation. These materials consisted of the following:

1) Black and white and color infrared photographs providing stereoscopic coverage of the watershed.
2) Two paper copies of the soil map with legend.
3) Two transparent copies of the soil map.
4) Two paper copies of the landuse and cover map with legend.
5) Two transparent copies of the landuse and cover map.
6) In some but not all, copies of the transect data sheets and field notes were also provided.

The USEPA provided the RCC with copies of US Geological Survey (USGS) topographic maps with the watershed boundaries outlined. These maps also served as locator maps to aid in locating the watershed. The USEPA selected the mapping units to be transected in conjunction with watershed map evaluation. The transecting was to be done on 60 mapping units in the region and, due to the time required to make the transects, it was necessary to make the transecting part of the qualitative evaluation. Due to this, part of the map delineations were preselected for checking; however, specific map delineations were randomly selected by the RCC. Other areas traversed by the RCC were those crossed while going to or coming from transected areas or by random traverse across portions of the watershed. The random traverses were selected by the RCC to permit checking as many different delineations as possible on a variety of landscapes. The goal in the qualitative evaluation was to evaluate 20 to 50 percent of the map delineations.

Landuse and forest cover type maps were field checked while checking soil mapping. Also, vegetative cover was noted on transect data sheets. Depth-to-bedrock maps were not checked as part of the soil map evaluation as they are a direct reflection of the soil survey map. Depth classes I and II and in some cases class III, can be taken directly from the soils that are mapped. Depth classes IV through VI can be inferred from the mapped soils, but cannot be readily checked in the field unless there are numerous road cuts or other man-made excavations.

In making the map evaluation, the first step was to randomly select the map delineations of the map units that were assigned by USEPA for transecting. The transect lines were drawn on a paper copy of the soil map using a stereoscope with the aerial photographs to select a direction that crossed the delineation on a line perpendicular to the drainage where appropriate. Zig-zag patterns were used on very narrow delineations.

The next step was to stereoscopically draw the watershed boundary on the aerial photos. This provided an opportunity to check the accuracy of the watershed boundary. The watershed boundary on the photos was also used to orient a copy of the transparent soils and landuse maps to the aerial photos. Careful photo interpretation using a stereoscope helped to assess how well soil map delineation boundaries matched the observable landscape features. Also, photo interpretation was used to identify any areas on which the mapping appeared questionable. Aerial photograph interpretation of the color infrared photos was particularly useful in making preliminary checks of the landuse and cover type maps. Generally speaking the landuse and cover type maps were found to be quite accurate, and this accuracy is thought to be a direct reflection of availability of recent aerial photography.

The transparent soil map was used with both the aerial photographs and copies of the USGS topographic maps in evaluating soil mapping. The soils overlay copies were strictly line maps, therefore, overlaying on the aerial photo and topographic maps was necessary to relate map unit boundaries to identifiable reference points on the ground. In most cases, the overlays fit the aerial photo quite well, although there were the usual scale limitations of unrectified photography. In some cases, the flight line for the watershed was not in a straight line and stereo interpretation was more difficult.

After the above steps, the remainder of the evaluation was done as a field check of mapping in the assigned watershed. Following is a list of watersheds that USEPA assigned for field evaluation:

1) Moormans River, VA, Watershed ID 2B047089
2) Right Fork Clover Run, WV, Watershed ID 2C041045
3) Buffalo Creek, WV, Watershed ID 2C041039
4) Piney Creek, PA, Watershed ID IB041008
5) Fulton Run, PA, Watershed ID 2C041002
6) No Name, PA, Watershed ID 1D036017
7) Upper Dry Hollow, PA, Watershed ID 2C029002
8) Wolf Run, PA, Watershed ID 2C029020.

Summary of watershed evaluations and map unit composition of transected units will be discussed in the quantitative evaluation section of this report.

Watershed Evaluations

Moormans River, VA

The watershed mapping was evaluated August 3 to 7, 1988, and 26 of 62 delineations (42 percent) were checked. Line transects were made on 9 different map units. The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on all units checked except for two mappable areas of alluvium and a complex of alluvium and upland soil. The total acreage of the 2 checked areas along the Moormans River are quite small (6 to 8 acres) and relatively insignificant in a watershed of this size. The only other differences noted were naming of stoniness classes in a few cases and inclusions of non-skeletal soils in a map unit of skeletal soils and significant area of Catoctin soil in area mapped Myersville. The latter areas were renamed Myersville-Catoctin complex at final correlation.

There were no suggestions for changes or corrections on the maps. The alluvium is described as making up 10 percent inclusions in unit 137E rather than delineating the very narrow band in 2 areas along Moorman's River.

Right Fork Clover Run, WV

The mapping for this watershed was evaluated August 10 to 12, 1988 with 28 of 85 delineations (33 percent) checked. Line transects were made on seven map delineations. The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on map units checked. The continuous delineation of Ernest (135E) includes a small narrow band of alluvium in places and steep Gilpin soils in others. The area mapped Sensabaugh (136C-1) is mostly < 8 percent slope with pH of 5.3 at 61 cm and may be Dystrochrept rather than Eutrochrept. The latter situation involved 11 acres. Unit 136 C was combined with Craigsville at the final correlation. The only suggested change was the deletion of 13 map delineations of well drained soils on the watershed boundaries that are < 6 acres which were delineated because they extended outside of the watershed.

Buffalo Creek, WV

The mapping for Buffalo Creek was evaluated August 15 to 17, 1988, and 13 map delineations of 20 (65 percent) were checked. Line transects were made on 6 map delineations. Two were on map delineation 41F-1 which made up 949 acres of the watershed. The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on the map units checked. A large continuous area of 41F-1 (Gilpin) included small, very narrow bands of colluvial soils and alluvium along some drainageways. The area of Craigsville-Fluvaquents complex (110A) contains an estimated 80 to 90 percent Craigsville; it also included alluvial fans and colluvium at the mouths of side-hollows. The area of 19E-1 (Calvin) is largely a non-skeletal taxadjunct of the series. Other areas of Calvin contain more skeletal pedons. The red bedrock in the area is shale and siltstone rather than sandstone and weathers more readily. There were no suggested changes or corrections.

Piney Creek, PA

The mapping of Piney Creek watershed was evaluated August 29 to Sept. 1, 1988, and 33 map delineations of 140 for 24 percent were checked. Line transects were made on 12 map delineations. The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on the map units checked. Areas of 13C (Berks) that were transected contained more than 15 percent Weikert and would be a better match for unit 14C. Unit 36C-2 (Ernest), involving about 16 acres was a mixed area of well drained, moderately well drained and somewhat poorly drained colluvium with some moderately well drained alluvium. Wet spot symbols could have been used in the area as mapped to show the wetter inclusions. Of the 2 areas of Hazelton transected, 1 was dominated by Berks and Weikert soils, and the other was half Hazelton and half Berks. The areas of the two delineations (about 25 acres) were underlain by coarse grained sandstone in places, but where checked the soils were dominantly developed in siltstone and shale. There were no suggestions for corrections or changes on the map.

Fulton Run, PA

The mapping of Fulton Run was evaluated September 9, 1988, with 8 of 18 map delineations (44 percent) checked. Line transects were made on 2 different map units. Permission to enter lands on the southeast end of the watershed was denied by landowner.

The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located on all but one checked area. One map unit was delineated too broadly along northern boundary of the unit near a house. An area of about 4 or 5 acres of Hazelton C slope could have been included with adjacent unit of 46D-1. An area of about 7 or 8 acres was in cropland when the watershed was evaluated. The same area had been shown as pasture on the landuse and cover map. The latter area was on the west side of the watershed in map unit 96B-1. The mapper had made very good use of spot symbols to show inclusions of steeper, stonier and wetter areas. Spot symbols were used to show abandoned coal mines that were draining into the stream. There were no suggestions for corrections or changes on the map.

No Name (Locust Run), PA

The mapping for this watershed was evaluated September 12 to 15, 1988. Twenty-nine of 76 map delineations (38 percent) were checked. Line transects were made on 12 map delineations. The larger map delineations were designated by more than one delineation number.

The soil and landuse maps were found to be accurate and acceptable. The noted errors or departures in mapping were not extensive. Unit 19E-1 (Calvin) contained no red soils and is a better fit for Hazelton. This area is 30 acres in extent. Some checked areas of Laidig soils near mountain tops do not appear to be typical colluvial landscapes but soils in most cases appear to fit Laidig official series description. Due to interstratification of red and gray shale and sandstone there are inclusions of reddish soils in areas mapped as brown soils and vice-versa. The landuse segment of the landuse and cover map was correct. The upper slopes of Hazelton soils have a tree cover dominated by chestnut oak, not white oak. In the areas around map delineations 46B-5 and 46B-6 the cover is dominated by bear oak with some chestnut oak, pitch pine and white oak. The colluvial soils and lower two-thirds of Hazelton on hillsides is dominated by white oak as mapped. There were no suggestions for corrections or changes on the map.

Upper Dry Hollow, PA

The mapping of the watershed was evaluated September 19, 20 and 22, 1988 with 21 of 29 delineations (72 percent) checked. Line transects were made on five map delineations. Due to accessibility and considerations of time, transects were made near the highway on south side of the watershed.

The soil and landuse maps were found to be accurate and acceptable. Map unit boundaries were accurately located except as follows: The area of Basher (9A-1) should be extended along the southwest prong of the drainageway. This change will add about 10 acres to the alluvial unit. Also the alluvial soils in the watershed are skeletal and better fit the concept of the Craigsville series. Basher and Craigsville are in the same sample class. Two areas were noted of about 6 to 8 acres each of Meckesville soils on D slope that were included with Lech Kill soils on F slope. The mapper had covered these inclusions in mapping notes. Where checked, areas of Clymer soils include

Hazelton and vice-versa. In some areas the inclusions exceed the acreage permitted in the map unit description. Where checked, cover type 108 contains as much sugar maple as red maple. The larger flat mountain top along State Route 44 is dominated by American beech and maple and would better match cover type 60. Except as noted above, there were no suggested changes or corrections on the map.

Wolf Run, PA

The mapping of Wolf Run was evaluated September 24 to 27, 1988. The evaluation checked 27 of 72 map delineations (38 percent). Line transects were made on 8 map delineations. The soil and landuse and cover type maps were found to be unacceptable as mapped. The map was not judged to be entirely incorrect, however the overall quality of the soil map can be improved with additional checking and map revision. The watershed map was compared with the published soil survey of Centre County Area, PA. It appeared that the mapper had used many of the soil boundaries as on the published survey while dropping others. Alluvial soils along Wolf Creek, while being quite narrow, are generally greater than two acres and should have been retained on the DDRP map. An area of 46C near the head of Wolf Creek had been included in a unit of Clymer B slope on the published map and 46B on the DDRP map. The mapper chose to combine all areas of Clymer soils on the published map with Hazelton soils on the DDRP map. There are extensive areas of Clymer soils in the northern part of the watershed that should be mapped separately from Hazelton. The finished DDRP map had 3 or 4 common boundaries between units of 46B. These lines separated Hazelton (HsB) from Leetonia (LtB) and Clymer (CvB) on the published map. The mappers decision to combine Andover with Buchanan appears to be correct as no mappable areas of Andover soils were noted during the evaluation. Also, the mappers' decision to combine Leetonia with Hazelton appears to be correct. There are individual pedons that classify as Leetonia but, where checked, Hazelton soils dominate. The Clymer areas that were checked have < 15 percent stone cover.

The landuse and cover type map indicates the watershed to be dominantly white pine-northern red oak-red maple, forest cover type 20. The only occurrence of white pine observed during evaluation was in small (less than six acres) separated areas along Wolf Run. The upland areas were dominated by mixed oaks with a very few pitch pine. A burned over area was dominated by bear oak. A mappable area in the NE corner of the watershed was covered with goldenrod and contained no trees.

The above information was provided to the mapper October 2, 1988. In addition, copies of the soil and cover maps and aerial photos showing suggested areas for checking or revision were also provided to the mapper.

QUANTITATIVE EVALUATION

The map units to be transected by the RCC were selected by USEPA personnel. Specific map delineations of the selected map units were selected by the RCC.

Sixty transects were run as follows:

Map Unit	Number of transects
13C	3
14D	4
19E	4
24C	1
24D	1
24F	1
29B	4
36C	3
41C	4
41D	4
41F	4
45C	4
46B	4
46E	4
52B	3
56C	1
65C	3
70C	1
70D	1
126B	2
126C	2
137E	1
138F	1

Watershed Evaluations

Moormans River, VA

Transect #1, unit 70B-3. Four pedons were non-skeletal taxadjunct to Catoctin series; 5

pedons match Catoctin series; 1 is Lithic (46 cm to bedrock). The area is a fair match for the map unit description even though half of the pedons on the transect do not match the Catoctin Official Series Description.

Transect #2, unit 138F-11. Seven pedons were Myersville; 3 were Catoctin. Unit 138F was renamed Myersville-Catoctin complex at final correlation. The area is a good match for map unit description as renamed.

Transect #3, unit 70D-4. Nine pedons were Catoctin; 1 was taxadjunct of Cataska (probably Sylvatus). The area was a good match for the map unit description.

Transect #4, unit 24C-7. Seven pedons were Cataska; 3 were Lithic Dystrochrepts 15 and 16 inches deep to the R horizon. The Lithic Dystrochrepts (probably Unicoi) were a greater percentage than permitted in the map unit description. The area was a fair match for the map unit description.

Transect #5, unit 56C-1. Eight pedons were Lew, and 2 were non-skeletal taxadjunct of Lew. Also, the area along the transect had < 15 percent stone cover on the surface. The area was a good match for the map unit description (MUD), even with the above exceptions.

Transect #6, unit 70C-4. Ten pedons were Catoctin and the area was a good match for the MUD.

Transect #7, unit 137E-1. Ten pedons were Lew. The stone cover ranged from 10 to 30 percent and the unit was not rubbly; otherwise, the area was a good match for the MUD.

Transect #8, unit 24D-7. Eight pedons were Cataska; 1 was non-skeletal taxadjunct (Sylco); 1 was loamy-skeletal Lithic Dystrochrept (Unicoi). The area was a good match for the MUD.

Transect #9, unit 24F-2. Nine pedons were Cataska; 1 was Lew. The area was a good match for the MUD.

Right Fork Clover Run, WV

Transect #1, unit 41C-7. Eight pedons were Gilpin; 2 were Weikert. The area was a good match for the MUD even though Weikert is 20 percent.

Transect #2, unit 41D-10. Eight pedons were Gilpin; 2 were fine-loamy taxadjuncts of Weikert. The area was a good match for the MUD.

Transect #3, unit 41C-12, Ten pedons were Gilpin. The area is a good match for the MUD.

Transect #4, unit 41C-6. Seven pedons were Gilpin; 1 was Weikert; 1 was non-skeletal taxadjunct of Weikert and 1 was a moderately deep, moderately well drained soil that was not named. The area was a fair match for the MUD.

Transect #5, unit 41F-4. Ten pedons were Gilpin. The area was a good match for the MUD.

Transect #6, unit 41D-11. Nine pedons were Gilpin; 1 was Gilpin taxadjunct due to texture of the C and Cr horizons. The area was a good match for the MUD.

Transect #7, unit 41F-7. Seven pedons were Gilpin; 2 were Weikert; 1 was Shelocta or Rayne. The area was a good match for the MUD.

Buffalo Creek, WV

Transect #1, unit 41D-4. Eight pedons were Gilpin; 2 were Weikert taxadjunct with < 35 percent rock fragments in the profile. The area was a good match for the MUD.

Transect #2, unit 41F-1. Eight pedons were Gilpin; 1 was non-skeletal taxadjunct of Weikert; 1 was unnamed Lithic Udorthent 15 cm to bedrock. The area was a good match for the MUD.

Transect #3, unit 41C-1. Seven pedons were Gilpin; 1 was reddish taxadjunct of Gilpin; 1 was reddish taxadjunct of Weikert (Klinesville); 1 was Berks. Except for the occurrence of Berks, the soil is a good match for the MUD.

Transect #4, unit 19E-1. Seven pedons were non-skeletal taxadjunct of Calvin; 2 were Gilpin; 1 was Calvin. The area is not a good match for the MUD.

Transect #5, unit 41F-1. Seven pedons were Gilpin; 1 was Weikert; 1 was non-skeletal taxadjunct of Weikert; 1 was Ernest. The area was a good match even though the Weikert exceeded the specified percentage in the MUD.

Transect #6, unit 41D-6. Eight pedons were Gilpin; 1 was skeletal taxadjunct of Gilpin; 1 was Weikert. The area was a good match for the MUD.

Piney Creek, PA

Transect #1, unit 13C-4. Three pedons were Berks; 3 were non-skeletal taxadjunct of Berks; 4 were Weikert. The area was appropriately mapped; however, the transect was not a good match for the MUD.

Transect #2, unit 14D-8. Five pedons were Weikert; 5 pedons were Berks. The area was a good match for the MUD.

Transect #3, unit 36C-1. Seven pedons were Ernest or Ernest taxadjunct (not mottled in the top 25 cm of argillic); 1 was Craigsville; 1 was Berks which we could not dig due to rock fragments; 1 was Brinkerton. The area was a good match for the MUD.

Transect #4, unit 36C-2. Four pedons were Ernest or Ernest taxadjunct (no fragipan, moderately well drained colluvium); 4 pedons were Brinkerton or Brinkerton taxadjunct (no fragipan); 1 was Blairton; 1 was Philo. The line of transect was not a good match for the MUD.

Transect #5, unit 13C-2. Five pedons were Berks; 4 pedons were Weikert; 1 was Dekalb taxadjunct. The area was appropriately mapped; however, the line of transect was only a fair match for the MUD.

Transect #6, unit 14D-14. Six pedons were Weikert; 4 were Berks. The area was appropriately mapped but the line of transect was dominated by Weikert and was only a fair match for the MUD.

Transect #7, unit 13C-6. Six pedons were Berks; 1 was Weikert; 2 were Calvin; 1 was Klinesville. The area was a fair match for the MUD which does not permit reddish soils.

Transect #8, unit 14D-18. Six pedons were Berks; 2 were Weikert; 2 were Calvin. The area was appropriately mapped but the transect was only a fair match for the MUD due to Calvin pedons.

Transect #9, unit 45C-1. Two pedons were Hazelton taxadjunct (too silty); 3 were Weikert; 5 were Berks. The area was not a match for the MUD.

Transect #10, unit 36C-3. Seven pedons were Ernest or Ernest taxadjunct (no 2 chroma mottles in Bt); 3 were Brinkerton or Brinkerton taxadjunct. The area was appropriately mapped; however, line of transect had more Brinkerton pedons than permitted in MUD.

Transect #11, unit 45C-2. Five pedons were Hazelton or Hazelton taxadjunct; 5 pedons were Berks. The transect is not a good match for the MUD.

Transect #12, unit 14D-4. Six pedons were Berks; 4 pedons were Weikert. The area was a good match for the MUD.

Fulton Run, PA

Transect #1, unit 29B-1. Eight pedons were Clymer; 1 was Dekalb taxadjunct (not skeletal and argillic horizon); 1 was Nolo or Nolo taxadjunct. The area was a good match for the MUD.

Transect #2, unit 46E-1. Ten pedons were Hazelton. The area was a good match for the MUD.

No Name, PA

Transect #1, unit 19E-6. Eight pedons were Calvin; 1 was Kleinsville; 1 was Lech Kill or Calvin taxadjunct (> 102 cm to bedrock, no argillic). The area was a good match for the MUD.

Transect #2, unit 52B-2. Nine pedons were Laidig; 1 was Buchanan. The area was a good match for the MUD.

Transect #3, unit 19E-1. Ten pedons were Hazelton. The area was not a match for the MUD.

Transect #4, unit 52B-3. Ten pedons were Laidig. The area was a good match for the MUD.

Transect #5, unit 46B-6. Ten pedons were Hazelton. The area was a good match for the MUD.

Transect #6, unit 19E-9. Nine pedons were Calvin; 1 was Calvin or Lech Kill taxadjunct (> 102 cm bedrock, no argillic). The area was a good match for the MUD.

Transect #7, unit 52B-4. Eight pedons were Laidig; 1 was Dekalb; 1 was Hazelton. The area was a good match for the MUD.

Transect #8, unit 46B-5. Six pedons were Hazelton; 4 pedons were Laidig. The area was appropriately mapped. Transect started in small area of Laidig soils at watershed boundary and was only a fair match for the MUD.

Transect #9, unit 65C-2. Eight pedons were Meckesville; 2 were Laidig. Even though Laidig is 20 percent of pedons on transect line, the area was a good match for the MUD.

Transect #10, unit 65C-1. Eight pedons were Meckesville; 2 were Laidig. As in transect #9, the area was a good match for the MUD.

Transect #11, unit 65C-8. Ten pedons were Meckesville. The area was a good match for the MUD.

Transect #12, unit 46E-3. Nine pedons were Hazelton; 1 was a reddish taxadjunct of Hazelton. The area was a good match for the MUD.

Upper Dry Hollow, PA

Transect #1, unit 45C-2. Nine pedons were Hazelton; 1 was Clymer. The area was a good match for the MUD.

Transect #2, unit 29B-3. Six pedons were Clymer; 4 were Hazelton. The area was appropriately mapped; however, there was more Hazelton in the line of transect than permitted in the MUD.

Transect #3, unit 45C-5. Seven pedons were Hazelton; 3 pedons were Clymer. The area was appropriately mapped; however, there was more Clymer in the line of transect than permitted in the MUD.

Transect #4, unit 29B-5. Eight pedons were Clymer; 1 was Cookport taxadjunct; 1 was Hazelton. The area was a good match for the MUD.

Transect #5, unit 29B-1. Six pedons were Clymer; 4 pedons were Hazelton. The area contained more Hazelton than permitted, and was only a fair match for the MUD.

Wolf Run, PA

Transect #1, unit 126C-1. Five pedons were Buchanan or Buchanan taxadjunct (no low chroma mottles in the Bt horizon); 5 pedons were Laidig. The unit does not include Laidig and the area was only a fair match for the MUD.

Transect #2, unit 46E-6. Six pedons were Hazelton; 2 were Clymer; 1 was Laidig; 1 was Udifluvent. The area was a good match for the MUD.

Transect #3, unit 126C-5. Nine pedons were Buchanan or Buchanan taxadjunct; 1 was Laidig. The area was a good match for the MUD.

Transect #4, unit 126B-4. Nine pedons were Buchanan or Buchanan taxadjunct; 1 was Laidig. The area was a good match for the MUD.

Transect #5, unit 46E-6A and 6B. Eleven pedons were Hazelton or Hazelton taxadjunct (too silty); 1 was Laidig; 1 was Wharton. The area was a good match for the MUD.

Transect #6, unit 126B-2. Nine pedons were Buchanan or Buchanan taxadjunct (depth to mottling and texture); 1 was Laidig. The area was a good match for the MUD.

Transect #7, unit 46B-17. Seven pedons were Hazelton or Hazelton taxadjunct (mottling below 61 cm); 3 were Clymer taxadjunct (mottling at about 74 cm). The area contained a mappable unit of Clymer soils. Aside from the Clymer, the area was a fair match for the MUD.

Transect #8, unit 46B-4. Two pedons were Hazelton or Hazelton taxadjunct (not skeletal); 1 was Cooksport taxadjunct; 6 pedons were Clymer. The area is not a match for the MUD.

General Comments on Findings of RCC Transects

Of the 60 transects run, 40 were judged to be an acceptable match for the MUD; 14 were judged to be a fair match; and 6 were not acceptable matches with the MUD. The 41 transects that are acceptable matches with the MUD are not exact matches when considering only a single transect of 10 points. In this situation, 2 pedons of an included soil will indicate an excessive occurrence of the inclusion, but when many transects are run the percentage of dissimilar inclusions will average out. The 14 transects that were judged to be only fair matches were the best match within the limits of the legend and were not thought to be serious discrepancies. In 6 transects, a named inclusion made up 40 percent of the pedon sites; in 4 transects a named inclusion made up 30 percent of the pedon sites; in 2 there were 20 percent inclusions of reddish soils that were not covered in the map unit description; in 1 there was 40 percent non-skeletal taxadjunct of the named series; and in 1 the named soils of a complex were reversed.

Of the 6 transects not making an acceptable match for the map unit description; in 2 none of the pedons were the named soil; in 2 only 20 percent of the pedons were the named soil; in 1 only 10 percent was the named soil; and in 1 only 50 percent was the named soil.

Comparison of composition and naming of map units from RCC transects with the map unit composition database was made. These comparisons are made only for units on which the RCC had 3 or 4 transects. Soils indicated as taxadjuncts of the named soil were considered as the named soil since taxadjuncts do not affect sample class. Transects judged not acceptable were not used in these comparisons. This involved 1 transect on 19E and 1 on 46B.

Unit Transected: 13C, 3 transects, Berks channery silt loam, 8-15 percent slopes

Composition and Name	
Composition Database	RCC Transects
80% Berks	53% Berks
10% Weikert	30% Weikert
5% Bedington	7% Calvin
5% Blairton	5% Klinesville
	5% Dekalb

Name based on RCC transects - Berks-Weikert complex, 8-15% slopes

Unit transected: 14D, 4 transects, Berks-Weikert channery silt loams, 15-25 percent slopes

Composition and Name	
Composition Database	RCC Transects
45% Berks	53% Berks
40% Weikert	42% Weikert
5% Dekalb	
5% Calvin	5% Calvin
5% Blairton	

Name based on RCC transects - Berks-Weikert complex, 15-25% slopes.

Unit transected: 19E, 3 transects, Calvin channery silt loam, 25-35 percent slopes

Composition and Name	
Composition Database	RCC Transects
85% Calvin	90% Calvin
5% Klinesville	3% Klinesville
5% Lech Kill	7% Gilpin
5% Meckesville	

Name based on RCC transects - Calvin channery silt loam, 25-35% slopes.

Unit transected: 29B, 4 transects, Clymer channery loam, 3-8 percent slopes

Composition and Name	
Composition Database	RCC Transects
80% Clymer	71% Clymer
10% Cookport	2% Cookport
10% Hazelton	23% Hazelton
	2% Dekalb
	2% Nolo

Name based on RCC transects - Clymer-Hazelton complex, 3-8% slopes

Unit transected: 36C, 3 transects, Ernest silt loam, 8-15 percent slopes

Composition Database	Composition and Name RCC Transects
70% Ernest	60% Ernest
10% Cookport	1% Philo
5% Wharton	3% Blairton
5% Brinkerton	30% Brinkerton
5% Gilpin	3% Berks
5% Hazelton	3% Craigsville

Name based on RCC transects - Ernest-Brinkerton complex, 8-15% slopes.

Unit transected: 41C, 4 transects, Gilpin channery silt loam, 8-15 percent slopes

Composition Database	Composition and Name RCC Transects
85% Gilpin	83% Gilpin
10% Weikert	15% Weikert
5% Lilly	1% Berks
	1 Unnamed

Name based on RCC transects - Gilpin channery silt loam, 8-15% slopes

Unit transected: 41D, 4 transects, Gilpin channery silt loam, 15-25 percent slopes

Composition Database	Composition and Name RCC Transects
85% Gilpin	88% Gilpin
10% Weikert	12% Weikert
5% Ernest	

Name based on RCC transects - Gilpin channery silt loam, 15-25% slopes

Unit transected: 41F, 4 transects, Gilpin channery silt loam, 35-70 percent slopes

Composition and Name	
Composition Database	RCC Transects
75% Gilpin	80% Gilpin
15% Rayne	3% Rayne
5% Laidig	2% Ernest
5% Weikert	13% Weikert
	2% Lithic Udorthent

Name based on RCC transects - Gilpin channery silt loam, 35-70% slopes

Unit transected: 45C, 4 transects, Hazelton channery loam, 8-15 percent slopes

Composition and Name	
Composition Database	RCC Transects
65% Hazelton	58% Hazelton
10% Dekalb	25% Berks
10% Clymer	10% Clymer
5% Buchanan	7% Weikert
5% Laidig	
5% Cookport	

Name based on RCC transects - Hazelton-Berks complex, 8-15% slopes
This is influenced by 2 transects from 1 watershed on which the map units were dominated by Berks and Weikert soils. Insufficient observations to accurately name from RCC transects.

Unit transected: 46B, 3 transects, Hazelton channery loam, 3-8 percent slopes, stony

Composition and Name	
Composition Database	RCC Transects
65% Hazelton	75% Hazelton
10% Clymer	13% Clymer
10% Leetonia	
5% Dekalb	
5% Laidig	12% Laidig
5% Rubble Land	

Name based on RCC transects - Hazelton channery loam, 3-8% slopes, stony

Unit transected: 46E, 4 transects, Hazelton channery loam, 25-35 percent slopes, stony

Composition and Name	
Composition Database	RCC Transects
70% Hazelton	86% Hazelton
10% Dekalb	2% Udifluvents
5% Leetonia	2% Wharton
5% Laidig	5% Laidig
5% Clymer	5% Clymer
5% Rubble Land	

Name from RCC transects - Hazelton channery loam, 25-35% slopes, stony

Unit transected: 52B, 3 transects, Laidig channery loam, 3-8 percent slopes

Composition and Name	
Composition Database	RCC Transects
80% Laidig	90% Laidig
15% Buchanan	4% Buchanan
5% Bedington	3% Hazelton
	3% Dekalb

Name based on RCC transects - Laidig channery loam, 3-8% slopes

Unit transected: 65C, 3 transects, Meckesville channery loam, 8-15 percent slopes

Composition Database	Composition and Name RCC Transects
65% Meckesville	87% Meckesville
10% Laidig	13% Laidig
10% Buchanan	
10% Calvin	
5% Leck Kill	

Name based on RCC transects - Meckesville channery loam, 8-15% slopes

5 CONCLUSIONS

The initial RCC field visits during the fall of 1987 consisted of a meeting in Bedford, PA to develop the initial mapping legend for the DDRP Mid-Appalachian Region and two visits to WV. One visit to WV was to participate in the initial protocol training meeting conducted by USEPA personnel. The second meeting was to review the mapping products and discuss the mappers' questions arising from their initial watershed mapping. SCS personnel from PA had not begun work on the Mid-Appalachian survey in 1987 and an initial visit was not made.

These sessions were particularly useful in WV because all involved personnel attended each session. PA had a participant at the initial protocol training session. The participant provided part of the leadership for mapping in Pennsylvania. Initial visits in PA after the mappers had time to map all or part of a watershed would have proved helpful.

The SCS progress field reviews that were evaluated by the RCC were complete and gave good insight into the progress of the mapping teams. The percentage of map units that was reviewed was not documented in most reviews. Some reviewers used the map adequacy check form, but did not give the total number of map delineations in complete watersheds. Other reviewers did not use the map adequacy check form. When reviews are made prior to completion of mapping, the extent checked cannot be provided. In this case the reviewer can only list the review stops and briefly discuss what was resolved at each stop. The cover letter with the PA review reports did an excellent job of listing review stops and covering what was done at each stop.

The field review report form provided a very useable format for submitting the review report. It provided uniform and consistent reviews of the different mapping teams and between the involved states. The review report should be revised to show the number of map delineations on completed watersheds and the number checked during the review. The RCC review of the SCS field reviews would have been more useful if done earlier in the mapping process.

The RCC made two formal progress field reviews. One was in WV, the other was in PA. The watershed mapping reviewed in WV was completed at the time of the review. The mapping team had done an excellent job of mapping and preparing notes to further document the work.

Representatives from the state SCS office made a concurrent progress field review.

The watershed mapping reviewed in PA was not entirely completed at the time of the review. The soil map was completed and only one minor deficiency was noted. The landuse and cover map required some revision. Additional field mapping notes would serve to better document the correlation decisions of the mapping team.

The independent evaluation of eight watersheds in the region indicated that the mapping is generally of acceptable quality. One watershed was judged unacceptable; however, it should be noted that the entire watershed was not considered to be incorrectly mapped. Revisions were required only on portions of the maps and information was provided to the mapper for use in making revisions.

The other seven watersheds contained only minor discrepancies (< 1% total area) or none at all. Noted errors or discrepancies were thought to be within the normal error of observation and did not warrant map revision.

Generally, noted discrepancies involved relatively small areas and mostly occurred as one of the following:

1) Soils were taxadjuncts to named series.
2) Soils were mapped as stony or bouldery with < 15% stone cover.
3) Few areas, mostly around watershed boundary where non-hydric soils were mapped out in units < 6 acres.
4) Complex where dominance of named soil is reversed.
5) Consociations where a second soil, usually listed as a named inclusion is sufficiently extensive to name as a complex.
6) Small areas of alluvial soils not mapped.

The landuse and cover type maps were generally very well done. Only minor discrepancies in cover type were noted and these usually involved identification of a major species in an area. Only one watershed was judged unacceptable where hardwood cover types had been identified as being dominated by conifers. The recently flown color infrared photography played an important role in the high quality of cover type mapping. In reviewing the cover type maps, it is necessary to keep in mind that the named cover types are designed for use over very broad regional areas, not areas as small as those shown on the watershed maps.

Problems involving landuse were, in most cases, due to a lack of complete definition of landuse classes. These problems were noted primarily on clear-cut areas and idle cropland or pasture that is reverting to brush cover. Areas that do not qualify as open land but do not have a recognized forest cover type cause difficulty in classifying cover type.

Transects were run on 61 map delineations representing 24 different map units. Forty-one were acceptable matches for the named map unit; 14 did not match well but were thought to be fair matches within the constraints of the mapping legend; 6 were not an acceptable match for the named map unit.

Of the 13 map units with 3 or 4 transects by the RCC, 9 would be named as in the map unit description; 4 would be named differently based on the calculated composition. In each case, units that would be named differently might have been complexes rather than consociations. This is due to a minor soil comprising more than 15% of the pedon sites on the transects. In one of these, 2 of the 4 transects were in areas that were incorrectly mapped, thus giving an inaccurate percentage of included soils.

Map units with 1 or 2 transects do not provide a sample with sufficient sites to permit judging the composition of the map unit. The line transects run during the quantitative evaluation were used in the qualitative evaluation of mapping. As such, they were used to assess only that part of the map unit that was actually covered by the transect. In some cases, areas observed on the transect were large enough that a different unit could be recommended where the map and transect did not match. In other cases, the transect, particularly on large delineations, did not indicate that the area was incorrectly mapped even if the transect composition did not match the map unit description. For example, a transect on a unit of Berks-Weikert complex may indicate a dominance of Weikert along the transect line, but an evaluation of the entire area will show that Berks dominates.

The time required to run the assigned line transects reduced the amount of time that was available to make random traverses across larger areas of map units; however, this did not materially affect the overall evaluation of watershed mapping. It should be noted that the percentage of map delineations evaluated, while being between 20 and 50 percent, were on the lower side generally. This is due to the large size of most of the evaluated watersheds in the region.

Overall impressions of the mapping activities is that all involved personnel did a careful and professional job and, based on the 20 percent sample, the watershed maps meet the requirements of the DDRP mapping protocols.